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WILLIAM THOMSON, LORD KELVIN.

Every great leader of men, whose life history is associated with an advance of the world, is endowed with some vivifying idea, some creative impulse, which is his mission to communicate, and which constitutes his message to mankind. Without this power to communicate an idea, a man may be preeminent as a doer of great personal deeds, but not as a leader. William Thomson, who has just left us, was both. The achievements of his own power were numerous and great. They were more than sufficient to give him renown throughout the civilized world. But he accomplished much more. In the course of a long and active life he exerted by his personality a marked and perceptible influence on the mental attitude of the English-speaking race. The message which he imparted was the importance of mathematics when applied to engineering. William Thomson's father, Prof. James Thomson, was a distinguished mathematician, and was appointed to the chair of mathematics at Glasgow University in 1832, an appointment which he held until his death in 1849. William, born in 1824, inherited his father's mathematical ability, and united it with a keen, practical engineering instinct. His first papers, produced at the age of 17, when a student at the University of Glasgow, were directed to the mathematical theory of heat. He went immediately afterward to study at Cambridge and distinguished himself there in applied mathematics. At Cambridge, he graduated in 1845 as second wrangler, and was appointed in the following year to the chair of natural philosophy at Glasgow University, when only 22 years of age. At that time there were scientific men in England, as well as in Europe. There were also engineers. But the scientists paid very little attention to engineering, and engineers were too busy to heed the remote and abstract work of the scientists. There was almost as little communication between these two sets of workers as though they respectively occupied different planets. William Thomson was trained as a scientist, but always looked upon science through the eyes of a man seeking to apply the forces of nature. Practical suggestions, useful deductions, opportunities for definite measurement continually appear in his writings.

His work in electricity commenced with electrostatics. In the pursuance of this work from its mathematical side, he designed a series of electrometers for the measurement of electrostatic quantities. He demonstrated mathematically that the discharge of a condenser must necessarily by oscillatory in character when the resistance of the discharging circuit falls below a certain critical value. Following his investigations into discharges, he developed electromagnetic theory mathematically and invented a long series of electromagnetic measuring instruments, notably the reflecting galvanometer and the gravity electromagnetic balance. About the year 1855, the Atlantic cable became seriously discussed as a commercial undertaking, and Thomson gave his attention to the mathematical theory of electromagnetic signals along submarine cables. His results completely over-

turned existing ideas among the electricians of those days, and revolutionized the industry of manufacturing long submarine cables. This was an epoch in British industry. It had been confidently believed that the formulas and equations of scientific men could only thrive in the atmosphere of a college laboratory, and that they would wither and die sterile when transplanted into a factory. Yet, when certain directors had courage enough to attempt the application of Thomson's mathematics to cable manufacture, the new ideas were found hardy enough to reap a great harvest for the practical men. Steadily from that time industries have opened their doors to prospective scientific ideas, and all engineers now recognize the importance to their business of a knowledge of applied mathematics. To us and to our time this idea seems trite and self-evident; but when Thomson first came to the chair of natural philosophy at Glasgow, the proposition would rarely have escaped ridicule.

In his journeys across the ocean, Thomson was swift to note practical needs and defects on vessels at sea. In whatever he examined, he took a keen interest. His first endeavor was to submit what he saw to mathematical analysis, in order to understand the subject as fully as possible. Then his instinct was to develop and supplement the knowledge in a practical way. He examined the mariner's compass, a device that sailors had used for hundreds of years with hardly any change. Iron ships were springing into existence to the great disturbance of the compass needle and bewilderment of the navigator. Thomson worked to the basis of the subject and brought out his structural modification of the compass, a model that is far superior to the type it displaced, and which has come into almost universal use. He looked into navigation and elaborated Sumner's method for computing the position of a vessel from a pair of observations capable of being made at times other than the occupied noon hour. He saw the cumbrous hempen rope sounding machine which occupied several hours over a single deep sounding, and he substituted the pianoforte wire, which enabled a similarly deep sounding to be made in about one-eighth of the time, and devised means whereby shallow-water soundings could be made without stopping the ship. To nearly every department of physical science Thomson made notable contributions. In his early lifetime the doctrine of the conservation of energy was a novel and debated subject. His work in the obscure phenomena of heat did much to cement the foundations of that doctrine, as well as to place the applied science of thermodynamics on solid ground.

Queen Victoria knighted Thomson in 1866, the year of the completion of permanent submarine telegraphic communication between the United States and Great Britain. She also created a barony for him in 1892. Although he was thus honored by a peerage, yet, in a sense, Thomson conferred more honor on the peerage than the peerage was capable of reflecting upon him. A title in such a case is a cloud rather than a luster to fame. His life and work were prominent among the graces and glories of the Victorian age. Thomson was twice elected to the presidency of the Institution of Electrical Engineers in Great Britain, and was also an honorary member of the American Institute of Electrical Engineers and of the National Electric Light Association. He several times visited America and always expressed his admiration of American enterprise, energy and practical quality. His lectures in Baltimore on "Molecular Dynamics and the Wave Theory of Light" have become classic. His jubilee at Glasgow in 1896, to commemorate the fiftieth year of his service as professor in the university, was attended by a remarkable gathering of scientific men from all parts of the world. He has left to us his papers, his scientific discoveries, his inventions, and his apparatus. But he has left to us, in addition, the spirit of investigation not merely for the sake of knowing, but also for the sake of doing and of serving our fellows. A host of men in all parts of the world carry on the work which he initiated for England and for the speakers of English. That work is the translation of the quantitative laws of the universe, the thoughts of Nature, into living ideas and into mechanical realizations for the benefit of all who live now or shall live hereafter.

Dividends.

It is an interesting fact that the dividends and interest declared and payable on and after Jan. 1, on securities quoted in New York, reach the enormous total of over $190,000,000. This, of course, is far from representing the total yield from stocks and bonds dealt in by the various exchanges all over the country, but is impressive enough as it stands, and the amount is about $10,000,000 more than a year ago. There is no reason to believe that it will not be $10,000,000 more in January, 1909, for the railroads and industries of the country are more likely to have a good year in 1908 than in the periods of depression and discouragement that have marked 1907. In addition to that, the policy of economy and retrenchment wherever not pushed too far should bring with it a larger net than heretofore, helped by lower and more reasonable prices for raw materials and supplies in general. It is a great mistake to suppose, as does President Gompers, of the united labor unions, that high prices and high wages mean high profits all around. Indeed, the converse is often nearer the truth, and labor is often a laggard in the struggle to keep up with the advancing prices that mark up the cost of living. All that is needed is that the wage fund shall not be impaired relatively to the scale of other things that enter into the political economy and social economy of a nation.

Elsewhere we print a very respectable list of the electrical dividends declared during the current week. The list is by no means complete, as it includes only what may be termed the dividends that are advertised. But they are symptomatic and show a general maintenance of rate. Even where dividends have been passed, the policy of prudence is avowed as to ensuring an early return to a distribution of the profits earned. A great many people owning these stocks as new purchasers are now receiving a larger return on their savings than they ever enjoyed before, and in due time they will find their capital increased by the reestablishment of normal values, whether of bonds or of stocks.

Power in the Piedmont.

Nothing gives a more striking idea of the industrial development of the New South than such reports of its power developments as are given in our columns this week. The cotton manufacturers have been turning homeward at an astonishing rate within the past decade and the general availability of water powers in the Piedmont region gives prospect of steady prosperity. As is well known, the Southern Appalachian region is one of very heavy rainfall, the largest in the country save for a portion of the Coast Range across the continent. The

streams descend rather abruptly to the coastal plain and the chances for cheap power development are of the best. It is worth noting that the electrical power already used in Southern mills rises to about 75,000 kilowatts (which exceeds in fact the amount used in the New England mills) and the total power used in the mills is about 225,000 kilowatts. The work of the Southern Power Company in utilizing the natural advantages of the Piedmont is far-reaching in its influence, and the Great Falls plant described in our columns takes rank not only as the largest hydro-electric plant in the South, but as one of the largest in the country. Thirty thousand kilowatt plants are and always will be scarce, since rich as our country is in water powers, it takes an unusual combination of large flow and high head to generate this amount of power. The Great Falls plant involves no difficult or sensational engineering. The hydraulic features of the system were determined by the fortunate topography, and it was possible to construct a very simple and convenient plant with the wheel cases actually built into the retaining wall of the forebay, giving ideal conditions for close regulation. The high head available, 72 feet, insures an economical hydraulic and generating plant and the whole installation impresses one as singularly effective and workable.

An interesting feature of the transformer plant is the fire-extinguishing equipment which is arranged to pour a stream of carbon dioxide gas into any transformer case. The case can also be emptied of oil by a channel into the tail race in case of fire. We are not aware that the efficacy of carbon dioxide in fighting a transformer fire has ever been tried out in practice, but on general principles it ought to be pretty effective, as oil needs a very liberal supply of oxygen for its combustion.

It is interesting to note that another plant nearly as large as that at Great Falls is already under way and that the power utilized and on the road to utilization by the Southern Power Company aggregates about 150,000 kilowatts. Were it not for the high freight rates, it is safe to say that the Piedmont region would rapidly become the cotton manufacturing center of the country. The rising cost of fuel must steadily act to drive manufacture into regions of cheap power, while cost of living and climatic conditions are decidedly in favor of the South. The mills that work up native cotton ought in the nature of things to be near the cotton supply, and if cheap power were reinforced by cheap transportation, the South would quietly come into its own. Enterprises such as are being carried out by the Southern Power Company are a national benefit, and the more we have of them, the better. It is not generally known that the Southern states have recently passed the New England states in the horse-power used in manufactures —with much of its water powers still to be utilized like this.

The Most Economical Shape of Winding for Electrical Measuring Instruments.

An interesting solution of a problem in the design proportion of electrical measuring instruments of the moving-coil type is given by Mr. A. P. Young, on page 1247 of this issue. The author shows that a coil revolving in a magnetic field of uniform density exerts the maximum torque per unit weight when it is circular in shape. An examination of the author's equations, or a little consideration of the physical facts upon which they are based, will show that the torque exerted by a coil in a uniform field varies directly with the area which the coil surrounds, quite independent of its shape. The weight of the coil evidently varies directly with its length. Thus, the maximum ratio of torque to weight is found when the shape of the coil is such that its area bears a maximum ratio to its length. It is seen at once, therefore, that the coil should be circular.

A comparison of the solution given by the author and the one outlined above, brings forward the two definitions of torque. That is to say, torque may be considered as the tendency to rotation produced by a pivoted conductor conveying current in a magnetic field, as has been done by the author, or it may be treated as that quantity by which speed must be multiplied in order to obtain mechanical power, as tacitly assumed above. A coil of any shape in a uniform field making one complete revolution in a certain time will have generated within it an e. m. f. which will vary directly with the area of the coil. The product of this e. m. f. and the current gives the power, which divided by the speed of rotation indicates the torque. Since for a certain value of current and a chosen number of turns, the e. m. f. and the power vary directly with the speed, the torque is independent of the speed. The torque, however, varies with the e. m. f. for constant speed, and hence the average torque varies directly with the area surrounded by the coil.

Parallel Operation of Alternators.

On page 1243 of the present issue there is given an instructive discussion of the parallel operation of alternators, by Mr. Waldo V. Lyon. The author has based his demonstration on the assumption of constant synchronous reactance of the armature circuits, and has properly called attention to the fact that his discussion has definite limitations. Certain of the characteristics of synchronous alternators and motors can be determined with a good degree of accuracy by the use of methods involving the assumption of constant synchronous reactance. In applying the methods, however, one should not forget the conditions under which the limitations are reached. Neglect to consider the limitations imposed by the cumulative inaccuracies in the assumption of constant synchronous reactance with decrease in the field strength of one alternator in parallel with another of constant field strength, has led the author to conclude that if the field circuit of the first alternator is opened, the entire load is removed from its prime mover, and its speed increases to at least the no-load value. The fact is, however, that so long as the alternators are held in step by the "synchronizing current" the power which each receives from its prime mover is in no wise affected by the variation in the field strengths, because the division of load between the prime movers is determined solely by mechanical considerations relating to the relative rates of supply of energy to them. If the load which the prime mover attempts to deliver to the alternator with the weakened field represents a torque greater than the "synchronizing current" can maintain, then this alternator no longer remains "in step" and it "drops the load." It is not proper to infer that the torque of the "synchronizing current" is zero when the field curcuit is open. As a matter of fact an alternator with projecting field poles can carry a considerable load when its field circuit is open, the magnetomotive force of the lagging wattless current supplied from other alternators serving for exciting the field magnets.

National Electric Light Association.

At the Washington convention of the National Electric Light Association last June, the Class "D" members (manufacturers) of the association made a most attractive exhibition of electrical apparatus and appliances. During the convention these exhibitors got together and offered to relieve the association of the troubles and responsibilities connected with the organization and maintenance of such exhibits at the annual conventions. The executive committee of the association approved a plan whereby the Class "D" members were to recommend annually an "Exhibition Committee" of their number. This committee, upon recognition by the president, would elect its own chairman, and organize to conduct the work pertaining to manufacturers' exhibits at the convention.

A nominating committee was formally appointed consisting of Mr. Geo. F. Porter, chairman, Atlantic Insulated Wire Company; Mr. T. G. Whaling, Westinghouse Lamp Company; Mr. Alex Henderson, American Circular Loom Company. The ticket presented by this committee to the Class "D" members has been approved by a mail ballot and accepted by Mr. Dudley Farrand, president of the N. E. L. A. This committee, known as the "Exhibition Committee," is as follows: Mr. F. H. Gale, General Electric Company; Mr. J. C. McQuiston, Westinghouse Companies; Mr. H. P. Heger, Allis-Chalmers Company; Mr. Rodman Gilder, Crocker-Wheeler Company; Mr. H. M. Post, Western Electric Company; Mr. C. P. Frey, Western Electrical Instrument Company; Mr. Benj. Wall, Metropolitan Engineering Company; Mr. James I. Ayer, The Simplex Electric Company; Mr. S. E. Doane, National Electric Lamp Association.

On Dec. 6, the committee met in the association rooms in New York, and elected Mr. F. H. Gale, chairman. A committee on by-laws and rules was appointed, and preliminary plans regarding the convention next June were discussed. The committee is, of course, subject to the executive committee of the association, and will co-operate fully with the president and other officers in making arrangements for the convention.

Development of Hudson River Power.

The application of the Hudson River Power Company for further privileges has been approved by the Public Service Commission of the Second District of New York State. The company proposes to extend its plant and to issue $3,232,000 5 per cent 40-year gold bonds to cover the expense for the proposed improvements and extensions. The opinion is by Commissioner Decker, and in it the policy of the commission is defined. Considerations set forth in the opinion include: "An order by the commission authorizing the issue of a portion of the bonds covered by a mortgage carries no implication of consent upon a future application as to all or any of the remaining bonds provided for in such mortgage. An application to issue additional capital involves the following, among other principal considerations: The purposes to which the proceeds arising from the sale of the securities are to be applied. The amount reasonably necessary for the consummation of such purposes. The character of the securities proposed to be issued. Whether any proposed construction or extension is likely to create unhealthful conditions, or otherwise constitute a public nuisance, infringe upon the vested rights or impede the necessary operations of other public service corporations, or interfere with the flow of water in a navigable stream to the extent of impairing its public use. Whether there is a reasonable prospect of fair return upon the investment proposed, to the end that securities having apparent worth, but actually little or no value, may not be issued with the sanction of the commission. Whether its new construction or improvement appeared feasible as a business proposition, but without reaching and announcing a conclusion that the proposed construction or improvement actually constitutes a safe or attractive basis for investment."

The Hudson River Electric Power Company proposes to construct and operate a storage dam, power dam, and electrical power plant on the Sacandaga River. It also plans to construct and operate electrical transmission lines for the proposed plant to Saratoga, Ballston, Mechanicsville, Troy, Albany, Watervliet, Schenectady, and Amsterdam. It intends to issue 3232 40-year gold bonds of $1,000 denomination, each bearing interest not to exceed 5 per cent per annum.

The company has agreed to sell to the state within three and one-half years the property and improvements involved in the storage dam, at a price not to exceed the amount of capital annually invested. By this agreement the state is to construct a much larger dam, which would benefit materially the company in its operation on the river below the storage site, including insurance of a steady supply of water in dry seasons.

Under a rule prescribed by the commission, the order to be issued in this case will contain provisions requiring the company to report under oath the sale, or sales, of the bonds authorized, the terms and conditions of such sales, and the amount realized therefrom; to make a verified report at least once every six months, showing in detail the use and application by it of the moneys so realized until such moneys shall have been fully expended.

Meeting of Pittsburg A. I. E. E. Branch.

At a meeting of the Pittsburg Branch of the A. I. E. E., held Wednesday, Dec. 4, in the lecture hall of the Carnegie Institute, Mr. J. H. Schoeff, of the Westinghouse Electric & Manufacturing Company, abstracted Mr. Armstrong's New York paper entitled "Comparative Performance of Steam and Electric Locomotives," emphasizing important points in the paper. Among them were the facts that at higher speeds the electric locomotive develops comparatively more tractive effort than the steam locomotive, and that the former is superior on mountain grades for hauling freight. He estimated the time a steam locomotive is idle during the day on account of standing at stations, at blocks, etc., and stated that on account of having to keep up steam all the time, the locomotive lost on an average 400 lbs. of coal per hour.

Mr. A. W. Gibbs, general superintendent of motive power of the Pennsylvania Railroad Company, sent a letter touching on some of the points along which the steam locomotive designer was working, as follows:

"You should bear in mind that the present capacity of the steam locomotive is largely a question of the capacity of the fireman to adequately stoke it, and this is the principal reason why there is a prevailing feeling that the older smaller locomotives were proportionately better than the modern large ones. The introduction of a mechanical stoker, which is probably a question of but a short time, will materially change this condition.

"Furthermore, considering an increase in the capacity of the road by whatever power is found most advantageous, will still leave the choke at the usual place, viz., the terminals. Moreover, the capacity of existing lines, especially double-track ones, is governed very largely by the presence on the line of trains having several rates of speed. While the use of a locomotive which will make high speeds with heavy trains will enable movements to be made which might not be made with a locomotive of slow speed, nevertheless what would most largely tend to economy of the movement is unification of the speeds. Finally, in considering the use of locomotives having sufficient power to maintain high speeds with heavy loads, it should not be overlooked that the construction of the electric locomotive as a vehicle which will maintain such high speeds without damage to track still requires attention."

Mr. Malcolm MacLaren, formerly of the British Westinghouse Company, discussed the subject of steam versus electric locomotive limitations. He compared the 1200-volt direct-curent and the alternating current systems. He showed that for some speeds and work the former is more economical, but, on a whole, discouraged the use of the high-voltage direct current system.

Mr. W. Cooper, of the Westinghouse Company, discussed the subject of steam versus electric locomotives from the control standpoint. He called attention to the fact that the electric trains can be braked by means of electrical control, while on some steam roads great trouble is experienced from hot brake shoes and wheels, the heat becoming so intense in some instances as to crack off the wheel flanges. He also pointed out that it is possible to run trains of practically any length by an arrangement of electric locomotives distributed through the train and controlled by one man, which is impossible with the steam locomotive.

Mr. N. W. Storer stated that it is not practical for steam roads to change over all their equipment at once from steam to electric, but that it would pay to electrify a great many terminals and mountain divisions with steep grades. Upon one occasion he was snowed up in a Northern Pacific train for several days with very little to keep him warm. The principal trouble seemed to be the inability of the locomotive to keep up steam on account of the severe cold. He pointed out that if the train had been propelled by an electric locomotive no delay would have been experienced, as the colder the motors the more efficiently they work.

Mr. C. F. Scott called attention to the greater cleanliness of the electric locomotive and pointed out that all the limitations of the steam engine have been exceeded by the electric locomotive. He had just received word from Indianapolis that an electric locomotive in use in that neighborhood now makes an average run of 586 miles per day.

Electrical Energy Transmission in Central Colorado.

At the time of the last convention of the Colorado Electric Light, Power and Railway Association, held at Denver in September. President George B. Tripp referred to the extensive electric transmission work under way in that state. As a matter of general interest, therefore, information has been compiled for a map of the central part of Colorado which shows some of the principal transmission lines built and projected. This map is shown in Fig. 1.

The oldest hydro-electric transmission system in the state is that of the Telluride Power Company, marked No. 2 on the map. Feeding into the same mining district, and interconnected with it, is a more recent project, the Animas Power & Water Company, which has a water-power plant on the Animas River, near Rockwood.

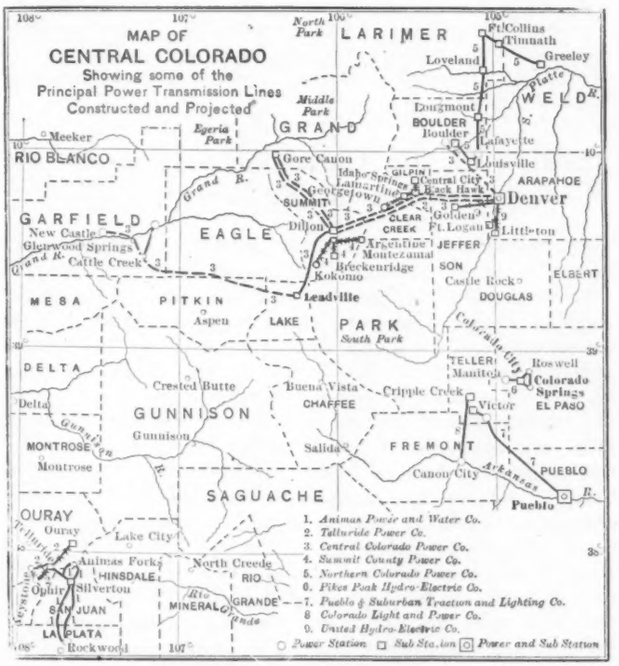
The next important transmission line to be built in Colorado after the Telluride Company began operations was that from Canyon City to Cripple Creek (No. 8), which is about 26 miles long. The power plant is operated by steam and is located near coal mines at Canyon City. It supplies most of the electric energy in the Cripple Creek mining district, where the price of coal is very high.

Another line originally built to supply energy to the Cripple Creek district is that now owned by the Pueblo & Suburban Traction & Lighting Company (No. 7). This has a water-power station in the mountains a short distance from Victor in the Cripple Creek region. There is also a transmission line in the opposite direction to Pueblo. The line to Pueblo, however, is unused much of the time because the energy can be sold to better advantage in the Cripple Creek district where coal is expensive. Coal is cheap at Pueblo, and should occasion require, sufficient apparatus could be put in at Pueblo to feed energy back to Victor.

In the Colorado Springs district is a system (No. 6) which is supplied with energy principally by the Pike's Peak Hydro-Electric Company, which has a water power with 2200 ft. head at Manitou. This feeds at Colorado City into a triangular network owned by the Colorado Springs Electric Company, which distributes the electricity. The Colorado Springs Electric Company also has a steam plant at the coal mines at Roswell and a sub-station at Colorado Springs. At the latter place it also maintains a steam plant for supplying a limited amount of exhaust steam for heating purposes.

A third interesting example of a steam power station located at coal mines and transmitting long distances is the recently finished plant of the Northern Colorado Power Company at Lafayette. This plant supplies energy to 11 towns. These towns are all located in highly-cultivated river valleys a short distance from the foothills. While coal is not high in price in these towns, the size of the plants in towns of from 2000 to 10,000 inhabitants is not such as to be conducive to economy, hence the reason for the transmission system. This plant is also to supply electric energy to the Colorado & Southern Railroad between Denver and Boulder.

The most ambitious project for energy transmission in Colorado is that of the Central Colorado Power Company. The lines proposed and under construction are those numbered 3 on the map. Construction has been begun on a station near Glenwood, a plant near Boulder and a power house in Gore Cañon. This company's plans cover future developments amounting to 75,000 kilowatts. Only a small part of this, however, is to be developed soon. The transmission lines are to be on steel towers with spans of varying length; the spans, between peaks where plenty of sag can be allowed, being as long as 3000 ft.. The towers will carry two circuits of copper conductors on suspension link insulators and two steel ground wires. The voltage is to be 50,000, 87,000 or 100,000, according to the way the transformers are connected. From Gore Cañon to Denver a duplicate line is planned. At the Boulder station water storage is provided, which can be used during high peak loads—an important point in a plant located near such a market as Denver. The Central Colorado Power Company has been engineered by Curtis & Hine, of Colorado Springs, who are also engineers of the Animas Power & Light Company.



MAP OF TRANSMISSION LINES.

The United Hydro-Electric Company, with a plant at Georgetown, supplies energy to several lines of towns in the Cripple Creek district.

The Summit County Power Company, in which Mr. Henry L. Doherty is interested, is projecting a system having a water power plant at Kokomo, to supply energy to mines in the Dillon and Breckenridge district. It will thus be seen that Colorado is very active in energy transmission work, both from water-power plants and from steam plants located at or near coal mines.

Cornell A. I. E. E. Meeting.

At the regular meeting of the Cornell University A. I. E. E. Branch, held in Sibley College, on Friday evening, Dec. 6, an audience of 273 was present. The speaker of the evening was Mr. W. N. Smith, electric traction engineer of Westinghouse, Church, Kerr & Co. Mr. Smith's paper, which was the first formal institute paper presented before the Cornell University Branch, was entitled "Practical Aspects of Steam Railway Electrification."

The speaker dwelt particularly upon the necessity of a study of electrification from all points of view. In the discussion Prof. H. W. Hibbard, head of the railway mechanical engineering department of Cornell University, expressed his appreciation of this kind of treatment of the problem. Prof. Hibbard felt that to a certain extent the steam railroad man has been ignored in the electrification problem. He emphasized that there is no antagonism to electrification on the part of steam railroad men, where the conditions seem to warrant its introduction. He did not feel, however, that electrification should be forced upon steam railroads, but rather that it should be adopted as necessary when conditions fully warrant such adoption. The steam railroad man is first and foremost a transportation engineer regardless of the source of motive power.

Prof. V. Karapetoff discussed the problem from the standpoint of power supply, comparing the steam locomotive to a "power plant on wheels." He also drew attention to the gasoline-electric car as having a bearing upon the subject of the evening. The informal smoker after the meeting was an important feature of the occasion, and was largely attended. Simple refreshments were served by the entertainment committee, and music was supplied by local talent. The text of Mr. Smith's paper will appear in due course in the *Transactions* of the institute.

Meeting of the Cleveland Section of the A. I. E. E.

The second regular monthly meeting of the Cleveland section of the American Institute of Electrical Engineers was held Monday evening of last week in the Electrical Engineering Building of Case School of Applied Sciences, following an informal dinner at the Rathskeller. The subject for the evening was "Transmission and Distribution Systems of the Cleveland Electric Illuminating Company," being a paper presented by Mr. Wallau. Both direct and alternating currents are produced at the central station. Direct current is furnished to the territory adjacent to the station on Canal Street. A sub-station on Seventeenth Street is equipped with rotary converters and transformers, to enable the company to furnish direct current at the proper potential to patrons.

Mr. Wallau said that there should always be spare cables installed to take the place of any that may break down, so that there may be no interruption of the service. Rotary condensers (over-excited synchronous motors), he said, had been installed on the premises of some patrons where the amount of service warranted, and others are installed in the sub-stations. The condensers should always be located in the vicinity where low power factor is the rule.

Three-phase feeders are used for the lighting circuits, so that energy may be supplied to small motors.

Mr. Lewis, who opened the discussion, described a number of other interesting points in connection with this system. His remarks were really an elaboration of the matter brought out in the paper. He has been associated with the author in the engineering work of the company.

Mr. Ricker referred to the question of grounding the neutral, which had been brought up, and gave an account of experiences that had come under his observation. A superintendent of a large plant in the East considers the importance of the neutral ground rather doubtful, he said. Breakdowns and interruptions of service are likely to result. Speaking of the use of an auxiliary discharge-gap, Mr. Ricker said that it has been known to cause oscillations that produce very high momentary voltages, the result of which is sometimes a discharge from an unexpected point.

In replying to some of the questions asked, Mr. Wallau said that the neutral was grounded in the first place as a means of safety to the men. While the grounding has led to some trouble with return currents over the wires, it has also resulted in smooth working of the automatic circuit breakers. The static dischargers consist of three 23-volt lightning arresters connected in series and connected with the ground with slight resistance, about 6½ ohms, current capacity, 500 amperes. The resistors consist of concrete blocks with metal strips set in and connected in multiple between the neutral point and the ground.

The low power-factor of the system, he said, is due to the large number of induction motors. Often motor salesmen sell motors of too high a rating, and such machines demand an excess of wattless current.

Motor-generator sets can not be installed on the premises of patrons, because of the attention they require. In the sub-stations the rotary condensers increase the power-factor very materially. Some of the condensers used were designed especially for the company, while others are not of special design.

Lightning arresters are installed on poles where the lines are connected to the underground cables, in order to prevent lightning disturbance from entering the cables at all. He believes this a better plan than having the arresters at the sub-stations. Since railway tracks were well bonded and the lighting lines arranged so that the cables were positive to the rails, there has been little variation in the potential from that cause.

American Copper Production.

The U. S. Geological Survey has just given out some interesting figures as to copper production in this country in 1906. They are summarized below:

Production of copper:			
Smelter output	pounds		917,805,682
Value of domestic production of copper			$177,595,888
Mine production	pounds		916,971,387
Electric	do	648,614,592	
Lake	do	205,608,382	
Casting	do	33,459,413	
Total:			
Domestic	pounds		887,682,387
Domestic and foreign	do		1,079,052,409
Total ore treated	short tons		19,743,000
Average yield of copper	per cent.		2.15
Copper ore treated	short tons		18,000,000
Average yield of copper	per cent.		2.50
Imports, in terms of refined copper	pounds		215,402,841
Exports, in terms of refined copper	do		446,750,711
Consumption:			
Electrical purposes	pounds	340,000,000	
Brass manufacture	do	210,000,000	
Copper sheets, etc.	do	35,000,000	
Castings, etc.	do	100,000,000	
Total	pounds		685,000,000
Prices of refined copper:			
Electrolytic	cents per pound		19.30
Lake	do do		19.55
Castings	do do		19.10
World's production	pounds		1,596,973,700

The bulk of the copper of domestic origin turned out by the smelters in 1906 was derived from approximately 19,743,000 tons of ore. This tonnage represents the quantity of ore which reached the copper smelters during the year either directly in smelting ore or indirectly—for example, in the form of concentrates—and it includes a considerable quantity of ore which was not mined expressly for its copper content. Ores in which the copper is of subordinate importance comprise dry or siliceous gold and silver ores, lead ores carrying sufficient copper to make its recovery profitable, cupriferous zinc and pyritic sulphur ores the "cinders" of which are subsequently smelted for copper, and ores mechanically concentrated for values other than copper. Ores of this class can not be separated sharply from distinctly copper ores, and the figures representing their quantity (1,700,000 tons) are only approximate.

Of the total ore tonnage approximately 5,021,000 tons, or about 26 per cent, were of sufficient richness or of so favorable

metallurgical character as to be smelted without concentration. The remaining 14,722,000 tons were concentrating ores, from which were produced 2,985,000 tons of concentrates, the average concentration being slightly under 5 into 1. A small quantity of copper was produced without the mining of any ore by the treatment of mine waters, and included with the concentrating ores is a small tonnage extracted by leaching processes. In both cases the copper was recovered from solution by replacement of scrap iron, and the resulting "precipitate," or cement copper, which may be regarded as a high-grade concentrate, went into the smelters.

Luncheon to Mr. Arthur Williams.

At the Engineers' Club, New York City, on Dec. 18, a luncheon was given to Mr. Arthur Williams, chief inspector of the New York Edison Company, by his colleagues on the board of the American Museum of Safety Devices and Industrial Hygiene, in recognition of the decoration of Oficier de l'Instruction Publique conferred upon him by the French government. Mr. Williams, who is a past president of the National Electric Light Association and of the New York Electrical Society, was actively connected with the preparation of the "public welfare" exhibit made by his company at the Milan Exposition with great éclat and afterwards transferred to Paris, where it again attracted considerable attention. He has also taken an active and sympathetic part in the creation of the new Museum as an agency for the protection of the life and limb of the great American army of industrialists.

The luncheon was given in the banquet hall of the club, and while brief was a most enjoyable affair. No fewer than 60 attended, including Messrs. R. W. Gilder and R. U. Johnson, of the *Century Magazine;* S. E. Moffett of *Collier's Weekly;* Walter C. Kerr, a trustee of Cornell University; Prof. F. R. Hutton, of Columbia University; Dr. A. C. Bumpus, of the American Museum of Natural History; Rev. Percy S. Grant; H. G. Stott, president American Institute of Electrical Engineers; Dudley Farrand, president National Electric Light Association. All the electrical interests were represented, including a number of Mr. Williams' associates headed by Messrs. N. F. Brady and T. E. Murray. The technical press was also out in force. Dr. W. M. Habirshaw was present wath several other personal friends of the guest, and Mr. G. H. Guy appeared for the New York Electrical Society.

The following exercises were presided over by Mr. T. C. Martin, and the presentation of the order was made by Dr. W. H. Tolman, on behalf of the French Republic. Brief but admirable speeches were made by Dr. Josiah Strong, president of the Museum, and Mr. John W. Lieb, Jr., who gave a most interesting account of the insurance work of the New York Edison Company on behalf of its employees. Mr. Martin announced that the Travelers' Insurance Company, of Hartford, had taken a large space in the Museum which is soon to be opened to the public, this space to be called the "Industrial Chamber of Horrors," including examples of defective apparatus and appliances that have actually caused loss of life and limb. The Holophane Company has also equipped the Museum gratuitously with its globes and reflectors and laid out a lighting scheme in consultation with the consulting engineer. An appeal was made at the close of the luncheon for a small equipment of tools for the museum shop or laboratory, similar to that in the Munich Museum. Copies of the gold medal founded in the new Museum by the *Scientific American* were circulated for inspection.

Satisfactory Report on Westinghouse Electric.

Haskins & Sells, certified public accountants, in compliance with the request of the receivers have made an audit of the books and accounts of the Westinghouse Electric & Manufacturing Company, which was made public after the meeting of the creditors, last week. The consolidated and condensed statement of income of the Westinghouse Electric & Manufacturing Company, and subsidiary manufacturing companies in the United States, shows a balance available for the payment of interest and dividends for the seven fiscal years ended March 31, 1907, and for the seven months ended Oct. 31, 1907, as follows:

	7 mos. ended Oct. 31, 1907.	Total for 7 years and 7 mos. ended Oct. 31, 1907.	Average per annum for 7 years and 7 mos. ended Oct. 31, 1907.
Sales	$22,265,322	$181,723,643	$23,963,557
Cost of sales	19,334,540	154,411,675	20,361,979
Net earnings	$2,930,782	$27,311,968	$3,601,578
Other income	869,833	5,328,929	702,716
Total income	$3,800,615	$32,640,987	$4,304,294
Inventory adjustments, etc.	717,393	3,951,961	521,137
Net income applicable to int. and div'ds	$3,083,222	$28,688,936	$3,783,157

The credits made to the company's surplus account during the seven years and seven months ended Oct. 31, 1907, which are not included in the statement of earning and expenses, because they cannot be considered as income applicable to the payment of interest and dividends, being of an extraordinary and unusual nature and not dependent upon the regular operations of the business, are as follows:

Premium on capital stock sold during the period	$5,884,150
Profit on stocks and bonds sold during the period	1,465,890
Profit on real estate sold	84,200
Profit on exchange of assenting capital stock for non-assenting capital stock under terms of reorganization of 1892	2,357
Unclaimed dividends	126
Profit through adjustment of Sawyer-Man Electric Company accounts previously charged off (prior to the year 1901)	143,987
Miscellaneous	67,516
Total	$7,648,247

The charges made by the company against its surplus account for items of an extraordinary nature, which were not applicable to the income, prior to determining the amount available for interest and dividends, and which are not included in the income statement, have been as follows:

Interest	$6,682,414
Dividends on stock	14,384,632
Depreciation of sundry stocks and bonds, consisting principally of stock of Consolidated Electric Light Company, U. S. Electric Lighting Company, Multiphase Motor Company, Electro Magnetic Traction Company and Manhattan General Construction Company	1,290,177
Amount charged off in connection with closing up the Walker Company matters	981,056
Special charges for depreciation in addition to those included in the operating expenses	897,876
Premiums and commissions on debenture certificates purchased	45,535
Amount paid Westinghouse Glass Company for purchase of lease of property required by Allegheny Foundry	12,234
Fire loss, Chicago stock	18,219
State tax on increase of capital stock	25,111
N. Y. Stock Exchange fee for increase capital stock	650
Services of Trust Company in connection with capital stock Consolidated Electric Lighting Company	500
Cost of moving lamp factory from Pittsburg to New York	100,161
Devising and installing accounting system	52,000
Commissions on issues of capital obligations	780,000
Legal services and expenses in connection with the issue of capital obligations	14,418
Discount on ten-year collateral notes	202,703
Discount on convertible bonds charged off	158,333
Amount paid Geo. Westinghouse for payments made in the interest of the company to various officers, engineers and other employees of Electric Company, in addition to their regular salaries paid by the company during last 10 or 12 years	400,000
Miscellaneous	45,058
Total	$26,091,079

The increase in the surplus account of the Westinghouse Electric & Manufacturing Company and subsidiary manufacturing companies in the United States during the seven years and seven months ended Oct. 31, 1907, has amounted to $10,246,104, as follows:

Net income available for interest and dividends	$28,688,936
Other profit and loss credits	7,648,247
Total credits	$36,337,183
Charges made against surplus account	26,091,079
Balance, being the increase in the surplus account	$10,246,104

The creditors and stockholders of the Westinghouse Electric & Manufacturing Company who have been working out the details of the plan for raising new capital and restoring the company to its stockholders, after a long conference last week announced the organization of a committee of creditors, of which James N. Jarvie, representing the National Bank of Commerce and other financial institutions, was made chairman.

The committee comprises Richard Delafield, president of the National Park Bank; James N. Jarvie, representing the National Bank of Commerce and other financial institutions; Albert H. Wiggin, vice-president Chase National Bank; F. H. Skelding, president of the First National Bank of Pittsburg; Charles A. Moore, of Manning, Maxwell & Moore; Neal Rantoul, of F. S. Moseley & Company, of Boston. A seventh member residing in Chicago is to be added.

Electrical Energy from Wind Power.

According to U. S. Consul-General Richard Guenther, of Frankfort, in Germany wind motors as power generators for use in agricultural and industrial pursuits are rarely met with, but in Denmark their use has increased very greatly. The consul-general continues: Since 1897 the Danish Government has contributed about $28,000 for equipments and has even lately erected an experimental station at Askoc. A technical writer describes these experiments, which were made on the initiative of the Danish government, and also some of the electric works in Denmark which generate electricity by means of wind motors. According to his statements, motors with four wings have given the best results, as a smaller number of wings does not fully utilize the wind power, while a larger number acts detrimentally upon the wind current between the wings.

If a medium large wind motor is used with a wing surface of about 48 sq. meters (1 sq. meter equals 10.764 sq. ft), 8 horse-power is obtained at a wind velocity of 6 meters per second (1 meter equals 3.28 ft.). At a velocity of 8 meters the horse-power is more than doubled. A wind with a velocity of 8 meters per second is no rarity. The weather reports classify it as No. 3, while the highest wind velocity is No. 12. Since 1903 there has been in existence the Danish Electricity Company, as a result of whose agitation 30 larger and smaller wind-power electrical equipments are in operation in Denmark.

CURRENT NEWS AND NOTES.

CHILEAN WIRELESS.—The German Wireless Telegraph Company is negotiating with the Chilean government for the establishment of a wireless telegraph system required to connect Valparaiso and Punta Arenas.

NORTHWESTERN ELECTRICAL ASSOCIATION.—This body will hold its next annual meeting at the Hotel Pfister, Milwaukee, in the club room, on Jan. 15 and 16. Mr. R. N. Kimball, of Kenosha, Wis., is the secretary and treasurer.

LORD KELVIN'S REMAINS IN WESTMINSTER.—In a London dispatch it is stated that the body of Lord Kelvin has been interred in the nave of Westminster Abbey, upon the petition of the Royal Society. Other great leaders in science now lying there are Newton, Herschel and Darwin.

TELEPHONY IN CUBA.—At Havana, on Dec. 18, Fernandez de Castro, president of the Agrarian League, presented to Governor Magoon, on behalf of the league, a petition requesting the modification of the existing telephone law, so as ultimately to end the present telephone monopolies, which, the petition says, confine the telephone services within the boundaries of their respective municipalities. The league asks that unrestricted telephonic communication throughout the island be permitted and that all private lines be free from taxation.

WIRELESS IN THE ARMY.—Wireless telegraph experts at the U. S. Army station at Fort Omaha have, according to a dispatch from Omaha, made discoveries in the wireless field which permit of comparatively long distance telegraphing from very short towers. Among the possibilities of the new system is telegraphing to and between moving trains. On Dec. 18 messages were sent over a distance of 20 miles by using towers less than 20 ft. in height. The experts believe this distance can be lengthened very materially without increasing the height of the towers.

McGILL UNIVERSITY.—It is noted from Montreal, Canada, that the appeal for a $1,000,000 endowment fund for McGill University, to be subscribed by the citizens of Montreal, has been lost sight of in the trying circumstances through which the university has passed, in consequence of the burning of the Engineering and Medical buildings. This fact was brought out at the last meeting of McGill Corporation when the annual report was submitted. According to the report $1,000,000 would now no more than make good the actual loss sustained in consequence of the fines, and another $1,000,000 is required to provide sufficient revenue to balance the existing deficits. With regard to the financial aspect of the two fires, the sums received from the insurance companies aggregated $636,000, while the cost of the new Engineering building alone, with an additional story on the Workman building adjoining, and the demolition of the burned structure, is estimated at $512,000, without equipment.

NEW YORK STREET CARS.—The fact that New York City is very badly in need of more electric street cars on the tracks is clearly brought out by the report made to the Public Service Commission by Mr. A. W. McLimont, electrical engineer, working in conjunction with Mr. Bion J. Arnold, retained as consulting expert. An investigation has been made of the power houses, barns and 1600 of the 1900 cars. Of the cars examined, 105 were filthy, 401 had flat wheels, 786 rattled noticeably, 249 were without headlamps, 102 with broken glass, 1006 with noise from the gears. Mr. McLimont says: "My investigation of this property leads to the conclusion that the rolling stock equipment, car house repair facilities and lack of an effective system of repair, maintenance and repair departments are responsible for the undesirable service being given by the companies, inasmuch as the rolling stock affects it."

NEW YORK TROLLEY ACCIDENTS.—During September, October and November the street cars, elevated, steam and subway trains in the city of New York have killed 155 persons and have seriously injured 500 more. These figures are compiled from the reports filed with the Public Service Commission by the traction and railroad companies themselves. Prior to the inauguration by the Public Service Commission of its system of accident reports there was no adequate way of determining the number of people killed yearly within the city limits by the traction companies. The exact figures compiled from the reports would indicate that there have been between 600 and 700 persons killed every year, and that at least 2000 people have been maimed annually. It is needless to say that a large part of this is due to causes utterly beyond the control of the companies. The number of employees injured fell from 603 in October to 150 in November, showing what can be done by the exercise of more care on the part of the individual.

OCEAN WIRELESS.—A special dispatch from Copenhagen of Dec. 18 says that Prof. Valdimar Poulson, inventor of the undamped or continuous system of wireless communication, has maintained steadily wireless telephonic connection between his station at Lyngby, near Copenhagen, and the Weissensee station at Berlin. The distance between the two points is over 240 miles, but it stated that the messages were transmitted with clearness and accuracy. "I shall open a wireless telephone service to America, via Ireland, in February," said Prof. Poulson, "a service that will be open for the use of the public." The professor has officially notified the American Legation that he intended to establish a transatlantic wireless telephone service. A recent dispatch from Berlin said that a German company had been telephoning wirelessly from Nauen to various places in Germany 50 to 60 miles distant, and that the conversations had been conducted with clearness and precision. A London dispatch, dated Dec. 20, states that the German Ministry of War has bought the rights of Poulson's wireless telephone.

TOKIO TROLLEYS.—The municipality of Tokio, Japan, bought the local street railway system last week.

TELEGRAPH TO LHASSA.—The Chinese government has sanctioned the construction of a telegraph line into Lhassa, the capital of Tibet, and the residence of the Dalai Lama, the supreme head of the Lamaist hierarchy. This innovation was recommended by the Chinese resident at Lhassa, who, since the advent of the British expedition of 1904, has been working for the enlightenment of the Tibetans.

ELECTRIC EXAMINATIONS.—The U. S. Civil Service Commission, Washington, D. C., will conduct examinations in January for electrician and "lampist" at the St. Louis Custom House, salary, $1,000; electrical assistant, U. S. Signal Service at large, $900; mechanical and electrical draftsman, one at $1,200 and one at $1,500 in the office of chief of ordnance, U. S. War Department, and first-class steam engineer, custodian service, Omaha, Neb., $1,200, and for similar vacancies as they occur, from $1,200 to $1,600.

UNDER THE HUDSON.—Electric cars are now running under the Hudson River, between New York City and Hoboken, in the McAdoo tunnels or tubes. The cars will be run through the tubes for the next two weeks merely as a test of the electric system, signal scheme, and general control. The plan will also make certain whether any additional bracing is needed in the tubes themselves, although Chief Engineer Charles Jacobs is certain that there will be no difficulty of this sort. The cars, of a special model designed for the tunnel service, have already been tested on the lines of the Manhattan Elevated system and found satisfactory.

N. E. L. A. BULLETIN—The December issue of the *Bulletin* of the National Electric Light Association contains in addition to Association notes and the "Question Box," an article by Mr. F. H. Plaice on "Day Service in Small Towns" and another by Mr. L. B. Marks on "The Place of Illuminating Engineering in Central Station Practice." A note signed by Mr. W. H. Blood, Jr., points out the uses of the *Bulletin*, and another, by Mr. Paul Lupke, suggests the publication therein for discussion a paper each month similar to those presented before the annual convention. Mr. Blood also, in a letter to the membership, asks for certain data on insurance policy forms.

THE MINNEAPOLIS SITUATION.—The value of the Minneapolis General Electric Company's local property is $4,937,712, as estimated by D. C. and William B. Jackson, and city engineer Rinker. For nearly a year there has been a dispute between the company and the city as to reasonable rates for service. The company seeks a definite franchise which will enable it to finance its operations. It asks a rate schedule that will pay a fair return upon the investment. The city wants the rate-making power surrendered to it by the company, and the lowest schedule of rates. There has been much discussion of rates, which is far from being settled, but there is a general feeling now more favorable to the company.

PUBLIC SERVICE LAW.—It is stated from Albany that the governor is generally satisfied with the working of the Public Service Commission law, and believes that it will meet any condition that may arise. But there are a few passages where the change of a word or a sentence is needed to clarify the meaning. It will also be necessary to change certain portions in regard to the supervision of lighting companies to make the procedure conform to that which prevails in dealing with the railroads. As to enlarging the commission's work by including telephone and telegraph companies, Governor Hughes will have something to say after further consideration. There is no doubt that the law is susceptible of great improvement.

CAR LIGHTING.—The next monthly meeting of the American Society of Mechanical Engineers will be held Tuesday evening, Jan. 14, in assembly room No. 1 of the Engineering Societies Building, at 29 West Thirty-Ninth Street, New York. The subject will be "Car Lighting," the presentation being made by Mr. R. M. Dixon, president of the Safety Car Heating & Lighting Company, and will treat of the general subject of lighting of trains, showing the relative economies in the several systems, electric and gas. There will be in operation exhibits of different methods, such as the Pintsch mantle, the vapor mantle system, a new acetylene system, and several varieties of axle lighting by electricity, with their regulating and governing mechanism.

FRENCH LIGHTING DEVELOPMENT.—According to *L'Electricien* there were in France, on Jan. 1, 1906, no fewer than 1413 electrical generating stations, supplying 2912 localities, whereas the total number of gas works in France at the same date was only 824, serving 1209 different localities. Four out of the 87 departments contained over 100 places with a supply of electricity, viz., Aude, 176; Isère, 166; Doubs, 103, and Herault, 100. The department of Isère had the largest number of generating stations, 60 in all; and the Basses Pyrénées comes next with 43, due to the presence of water powers. More than two-thirds of all the works generate their electrical energy by hydraulic power, either alone or in conjunction with steam or gas engines, but 831 works have only water power. In 942 plants, the current generated is continuous, while 256 generate three-phase current, and 157 produce single-phase alternating current.

LIGHTING IN PARIS.—From time to time the shifting negotiations as to new plans for lighting Paris have been noted in these columns. The terms of the concession for the future supply of electricity in the city of Paris, drawn by the Municipal Council, have now, according to the *Journal de Débats*, been approved by a decree of the president of the republic. The period from Nov. 1 of the present year until Dec. 31, 1913, will be one of transition. The committee of the companies which have the sectional monopolies (secteur or district systems) will furnish the entire public and private supply energy at a fixed price. In the first six months the concessionaires, after approval of their agreement, will have to form a company, with a capital of $10,000,000, which will assume the name of the Compagnie Parisienne de Distribution d'Electricité. The concession will begin on Jan. 1, 1914, and terminate on June 30, 1940, with rights of reëntry on the part of the city at any date after June 30, 1924, on certain fixed terms.

ELECTRICITY IN TURKEY.—U. S. Special Agent W. A. Graham Clark says of conditions in Turkey: "Trade in Turkey suffers from several restrictions. In sending telegrams, for instance, every sentence has to be studied by the censor at Constantinople, and no message is allowed in cipher. Even consuls cannot use codes except when telegraphing direct to their governments or to their embassy at Constantinople. The cost is doubled by having to be sent first to Constantinople and then forwarded, and of course the normal cost is greatly increased by the prohibition of business codes. Electricity is regarded with suspicion, and telephones are prohibited throughout the Ottoman Empire. In this particular they are far behind the Chinese, whose leading merchants in the large cities are as familiar with the telephone as the merchant in the United States, and use it almost as freely. At Constantinople I was informed that the Sultan had just authorized one telephone line, and if this is so it will doubtless be followed by others within a short time. Several Turkish cities have gas works, but Damascus is the first city in the empire to have electric light. The electric lamps and an electric street-car system were only started in Damascus in the early part of this year, but already Beirut and other towns have obtained authorizations for similar projects."

RENSSELAER POLYTECHNIC INSTITUTE announces that it has inaugurated courses in electrical and mechanical engineering, leading to the degrees of electrical engineer and mechanical engineer. The recent gift of one million dollars by Mrs. Russell Sage insures laboratories in these branches of engineering unsurpassed by those of any school in this country.

NEW N. E. L. A. MEMBERS.—The December *Bulletin* of the National Electric Light Association gives the following list of new applications for membership during November: Citizens' Light, Power & Water Company, Ketchikan, Alaska; Consumers' Company, Limited, Coeur d'Alene, Idaho; the Electric Company, Huron, S. D.; Equitable Electric Light Company, Lake Geneva, Wis.; Jefferson Light, Heat, Power & Water Company, Jefferson, Iowa; Napa Valley Power Company, Calistoga, Cal.; Shore Electric Company, Red Bank, N. J.

REGULATION OF WIRELESS.—At Washington, D. C., on December 18, the U. S. Senate removed the injunction of secrecy from the treaty now pending before it that was adopted by the nations participating in the convention at Berlin on Nov. 3, 1906, providing certain international regulations for the operation of wireless telegraphy. Twenty-six nations took part in the convention. The regulations provide for the use of electric waves of uniform length by ships and shore stations, the publication of the charges for wireless telegrams and the establishment of an international bureau for the settlement of the accounts between ships and stations.

ELECTRIC MOTOR EQUIPMENT IN FOUNDRIES.—In a paper presented at the recent New York meeting of the American Society of Mechanical Engineers, Mr. A. D. Williams outlined the important advantages of electrical distribution of energy for foundries. For most purposes it is best to employ electric motors directly for the work to be performed. There are certain advantages in using compressed air for moulding machines. In order to avoid the expense of and loss in long air-lines, it is desirable to install small motor-driven air compressors. The disadvantageous leakage of hydraulic service systems can be prevented by using an electrically driven pressure pump and employing oil as the pressure fluid.

RADIUM CURES.—Writing to a London paper which recently published an article saying that the hopes the doctors entertained when radium was first discovered had received no measure of fulfilment, apart from some action on skin diseases, Sir William Ramsay says: "I must ask you to give publicity to the fact that the rodent ulcer, a terrible disease which chiefly attacks the face, can be cured with certainty by exposure for a few minutes at intervals to rays emitted from radium bromide." In this connection it is stated that the authorities of Middlesex Hospital, who are pursuing investigations as to cancer, are extremely well satisfied with the results obtained by radium in the treatment of this disease. They do not claim it is a specific in all cases, but say the percentages of successful treatments is notable.

DIVIDED RESPONSIBILITY.—Mr. A. H. Smith, vice-president and general manager of the New York Central Railroad, has been acquitted of manslaughter in connection with the wreck of the electric train at the Woodlawn curve, and the consequent loss of life. Justice Kellogg in his charge analyzed the testimony and said he did not believe one man capable of personally supervising such a system as the New York Central. Some of his powers, said the justice, had to be delegated to subordinates and to hold the general manager guilty of criminal negligence would be gross injustice. Justice Kellogg said the technical testimony was of little value as against the testimony of practical engineers. "It was humanly impossible," said the justice," for this defendant to know every switch, block signal circuit and curve of the system. Of necessity, the most he could do was to provide a general scheme for traffic and the safety of passengers. He must delegate some duties to others. I take it that we have not a great many complaints to make against the railroads. They seem to serve the people fairly well. But there are altogether too many accidents on railways. This is unfortunate. I hope that the general officers of such roads will take the matter in hand. I think this case has brought about good results in that it has brought to the attention of the railway officials the need for more care, especially in the matter of the restrictions of speed."

POWER IN THE SIERRAS.—According to advices from Fresno, Cal., Mr. Frank H. Short had proceeded to Washington to present to the department of agriculture the side of the case of the mountain power plant companies, claiming that unless restricted concessions are granted covering development work in the Sierra forest reserves power development companies now nearing completion will have to abandon their projects. Mr. Short intends to present the subject in such shape as to bring the matter up for Congress for helpful legislation. Not only do the forestry bureau regulations now require that the permits demand a charge for the use of water, but these permits are subject to revocation and are terminable in 40 years' time. Under these conditions the power companies would have to earn an added amount to pay the charges and to obtain returns on their investments. This burden, it is represented, would ultimately, fall on the water users in higher rates. Mr. Short says: "It is the old story of a government attempting to lay down domestic regulations from a distance of 3000 miles. The government does not understand conditions here and it must be enlightened. Taxes imposed by the government on power plants would not aid the county one whit. The money would go to Washington. But on the other hand, the companies would be forced to raise their charges for electric energy and the citizens wold have to pay the money." Mr. Pinchot's argument as government forester that all permits issued should be terminable, because if they are not, there is danger that the government's resources will gradually be lessened, might hold good in respect to coal beds or forests, but electric power is permanent and the fact that it is developed does not mean that there will be any less electricity available 40 years hence than there is to-day.

TELEPHONE TROUBLES.—In connection with complaints made against the Wisconsin Telephone Company at Milwaukee, some interesting data have been collated by Mr. W. F. Burgess, based on elaborate tests. His opinion is that the troubles arose chiefly from party lines, and the absence of correct methods on the part of the users. He suggested as a remedy that a time limit be placed upon the conversations over such 'phones. While he was assisting in an investigation of the Chicago company last year, he said that a case was brought before the hearing where a teacher of language gave half-hour lessons over the 'phone to her pupils. The telephone was of the four-party line variety. "One of the chief troubles in the Milwaukee telephone situation is that office men hire out desk room in their offices, with use of the telephone. This is common in Milwaukee, and the result is that there are three or four business men in one office, who use the same telephone. The outgoing calls in such a case are numerous, and a person trying to get connections on such a line, will find it always busy. People who do not understand the situation, blame the operator and claim that she wilfully gives them the busy signal. They then begin to complain and say that the operator is overworked, and that she has too many telephones to care for. The truth of the matter is, that the operator has an easier time of it when she can get the party, than she does when giving the busy signal. First she is required to test the line and, when she is informed by a click, that the line is in use, she has to plug in another jack, thus doubling the usual operations. Is it reasonable to expect that an operator will do more than is absolutely necessary? The telephone, which is so much used, should have a double track system, that is, a line for incoming calls and another for outgoing calls."

Southern Water Power Developments.

THE comparatively restricted area within a radius of a hundred miles about the City of Charlotte, N. C., known as the "Piedmont region," contains more than half the spindles and looms of the South. Within this fertile belt are located 360 cotton mills, operating 4,744,458 spindles, 110,258 looms and 2717 knitting machines. In the past decade there has been an increase of 160 factories, 3,123,243 spindles and 66,285 looms, due largely to the application of electric drive.

The abundant water powers for which this region is noted are now in a fair way to be adequately utilized for the purpose of driving the cotton mills of the district by electricity in place of steam, which is rapidly being superseded. There is at the present time more electricity used in the section about Charlotte for driving cotton mills than in New England, the old-time rival of the Southern spinning mill industry.

It is no longer necessary to locate mills in the low river bottoms away from the railroads in order to obtain cheap water power. Electric energy is transmitted from the streams to the factories which have been built on convenient sites along the railroads, and amid healthful surroundings. Electricity was first introduced into cotton mills at Columbia and at Anderson, S. C., in 1894. Now out of a total of 300,000 horse-power used by the cotton mills of the South, more than a third is in the form of electricity. The possibilities for future development in the Piedmont region, according to the estimates of experts, amount to an aggregate of 2,000,000 horse-power.

The Southern Power Company, one of the first corporations which realized the value of the unused power here, came into the section a few years ago, availed itself of the rights of the land owner to use water flowing through his lands, bought up land along the banks of the rivers, built dams, made reservoirs, and erected plants for the generation of electricity, which it distributes over hundreds of miles of transmission lines to the factories and the small towns throughout the region. Electrical energy is now distributed to Charlotte, N. C., the company's headquarters, from the Catawba River, 18 miles away, for operating street railways and for feeding lamp and motor circuits. Other towns in the vicinity where energy from the same source is available are Concord, Rock Hill, Kanapolis, and Statesville. The company charges $20 per horse-power per year for energy used 11 hours a day, six days a week. Steam power, under most favorable conditions, costs twice as much.

The Southern Power Company already has in operation two large electric plants, one called "Catawba" is rated at 10,000 horse-power and the other known as the Great Falls Plant has a rated output of 40,000 horse-power. The company is now carrying out plans for the development of 200,000 horse-power. It controls nine separate sites in the Piedmont section, where rapids occur between the head waters and the lowlands over a distance of 110 miles in all, and with an aggregate fall of nearly 1000 ft. A new plant, rated at 40,000 horse-power, is building at Rocky Creek, and another, rated at 24,000 horse-power, is building at Ninety-Nine Island, near Spartanburg. Similar developments are planned for Harseford Shoals, Lookout Shoals, Mountain Island, Landsford, Fishing Creek and Wateree.

Of the different power sites, controlled by the company, the one known as the "Great Falls" of the Catawba River offered the best opportunity for the initial development; so the work was begun here first. A railroad 12 miles in length was built to connect the Great Falls site with the railway centers of the state and to furnish transportation facilities for material of construction.

Before development, the Great Falls comprised a series of falls and shoals having a total head of 176 ft. over a distance of 8 miles, for the full utilization of which three separate developments will be required. The middle one, with a head of 72 ft. and receiving the run off from a drainage area of 4200 sq. miles, is known as the Great Falls Station and has just been placed in service. It is located on one side of an island, known as Mountain Island. A low spillway dam was erected across the river at the head of the island to deflect the entire volume of the river into the western channel. Across the western channel near the foot of the island is built a 30-ft. spillway dam, this dam deflecting the water into an almost natural canal which carries it about 1¼ miles, at which point is located an enormous retaining wall across the natural valley. Built into this retaining wall are eight 5200-hp hydraulic turbines of the twin horizontal type, enclosed in steel cases 15 ft. in diameter by 19 ft. long. Two of the waterwheels were built by the Holyoke Machine Company and the other six were built by the Allis-Chalmers Company. Steel feeder pipes of 7/16 in.

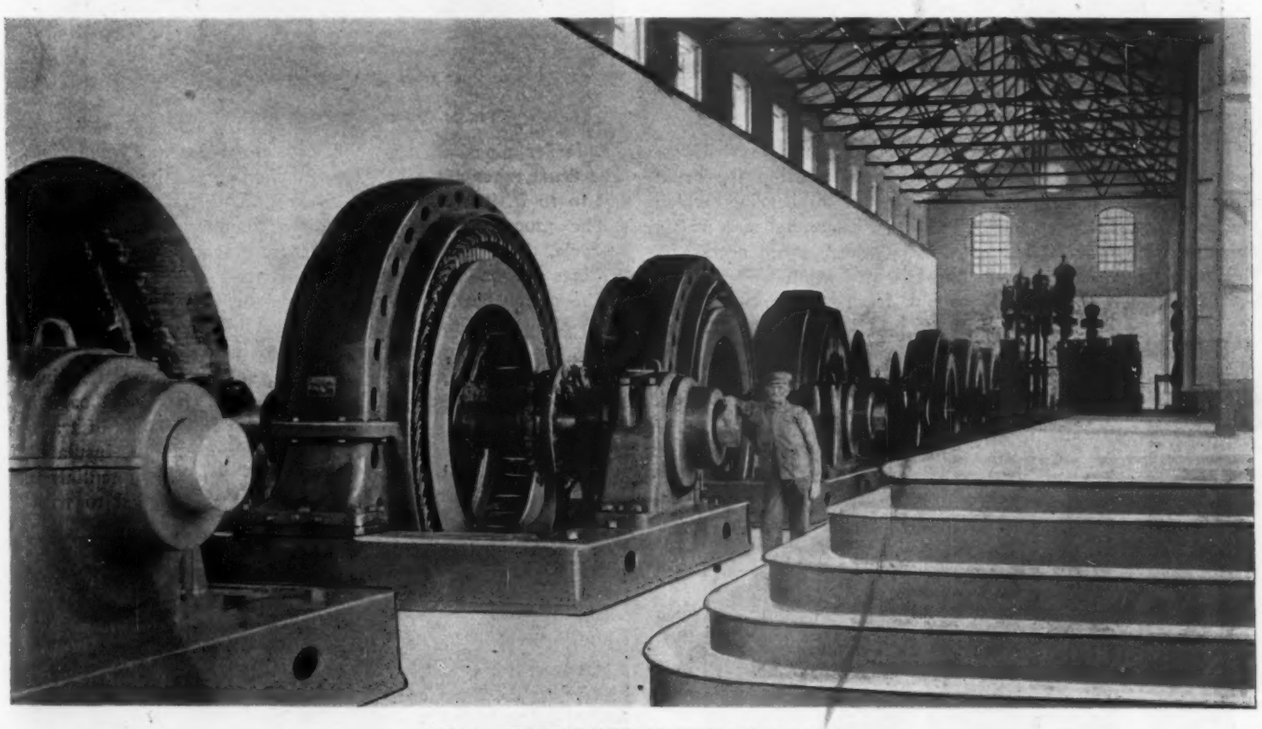


FIG. 1.—GENERAL VIEW OF GENERATOR ROOM.

plate are encased in the retaining wall, these feeder pipes being elliptical in form at the intake; dimensions, 16 ft. x 18 ft., gradually narrowing down to 15 ft. in diameter where the feeder enters the wheel case. The draft tubes are also built of 7/16-in. sheet steel, and are 11 ft. in diameter at the wheel case, gradually increasing to the point of discharge, where they are elliptical in shape, 11 ft. x 18 ft. A special feature in this construction is a tunnel extending the entire length of

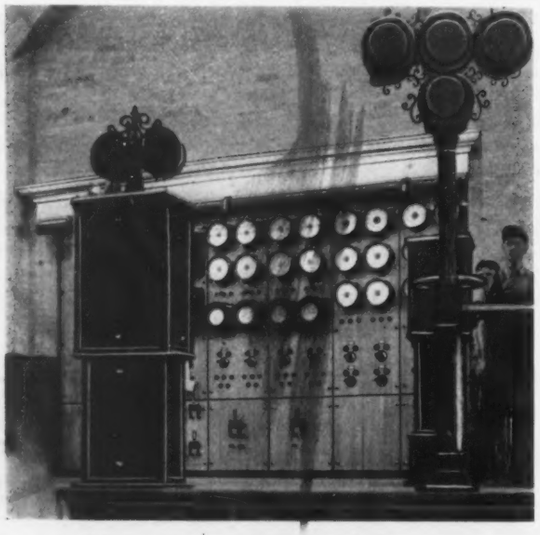


FIG. 2.—SWITCHBOARD.

the power house through the retaining wall and just back of the turbine cases. By this method of construction the usual outboard water bearing is replaced by an oil bearing, which may be easily gotten at and inspected. This tunnel also makes it much easier to get at any part of the wheels when necessary. This tunnel is 10 ft. in width and has an I-beam trolley overhead for carrying material to and from the power house.

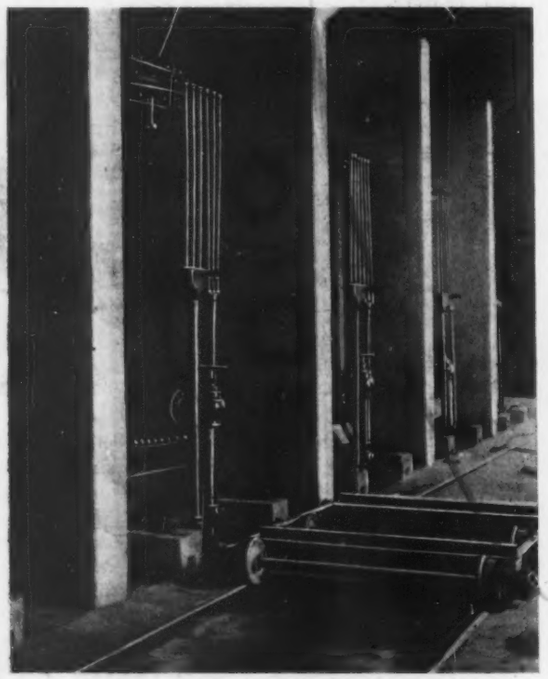


FIG. 3.— OIL-FILLED, WATER-COOLED TRANSFORMERS.

Arched openings from the power house enter the tunnel at several convenient points. The wheel cases are supportd on a very heavy steel foundation built up of 24-in. I-beams. Both bearings are ring oiling, ball and socket, of the generator type. They are rigidly connected to the head, the outer bearing being designed to take up the end thrust of the wheels. The gates are of the swivel type and so designed as to give the maximum efficiency at approximately three-quarter gate, which represents full load on the generators.

The two turbines for operating the exciters, also of Allis-Chalmers design, are similar in construction, being rated at 700 horse-power at 450 r. p. m. under a working head of 72 ft. At the intake the feeders for the exciter turbines are 6 ft. x 9 ft. gradually tapering to 6 ft. in diameter at the wheel case.

FIG. 4.—HIGH-TENSION OIL SWITCHES.

All feeder pipes are equipped with manholes and vent pipes. The draft tubes are 5 ft. 6 ins. in diameter at the case, flaring out to 10 ft. in width at the discharge end.

The 5200-hp turbines are direct connected to 3000-kw, 60-cycle, three-phase, 2300-volt generators and the two exciter turbines to 400-kw, 240-volt direct-current generators.

The switchboard is mounted on a gallery which stands about 6 ft. above the main station floor, thus giving ample space below for all cables, which are placed in racks on either side, the direct-current cables being on one side and the alternating-current cables on the opposite side. Behind the switchboard is the transformer house in which are placed four banks of transformers, each bank consisting of three 2000-kw oil-insulated, water-cooled transformers, which step up the potential to 44,000 volts.. The transformer casings are designed to with-

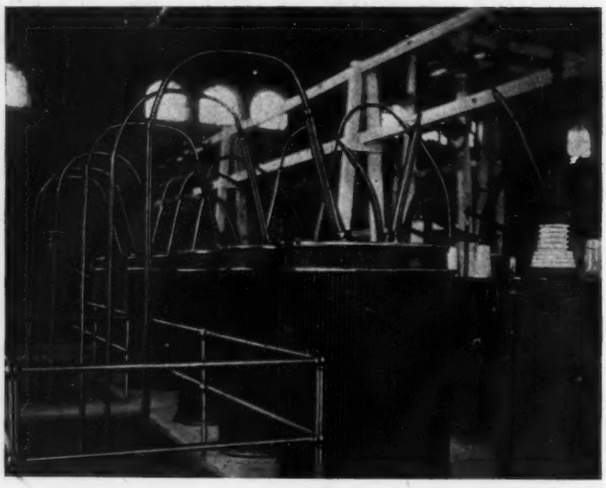


FIG. 5.—SERIES TRANSFORMERS AND CHOKE COILS.

stand a pressure of 150 pounds and are equipped with relief valves connected to a vent discharging outside of the building. The transformers are mounted on flanged wheels and stand in their respective compartments on rails supported on concrete pedestals as shown in Fig. 3, which also illustrates the

manner of shifting the transformers by means of the transfer car running on a track in front of the transformer compartments. A pipe system through which carbon dioxide may be admitted in case of fire connects all the tanks. The gas generator and pressure tank are placed in the basement and in addition to the transformer connections a pipe extends to the second story so that any apparatus on this floor may also be deluged in carbonic acid gas in case of necessity. The oil for the transformers may be supplied by gravity feed or by a pressure feed from a tank outside. By reversing the direction of rotation of the pump the oil may be withdrawn from the transformers and after passing through a filter, returned to the storage tank. Connections are also provided for discharging the oil into the tail race. An electrically-driven triplex pump supplies oil to the high-tension apparatus on the second floor of the transformer house through two pipe leads terminating in hose bibs in floor boxes.

Each generator is controlled through an instrument post and switch pedestal. Each post is equipped with an ammeter, voltmeter, wattmeter and field ammeter and in addition there are two synchronizers, two frequency indicators and four bus-bar voltmeters distributed among the several posts. Each control pedestal is equipped with a remote-control switch for operating an oil circuit-breaker, one field switch, a rheostat hand wheel,

FIG. 6.—POWER HOUSE, RETAINING WALL AND GATE HOUSE.

an eight-pint voltmeter receptacle, a meter shunt and a lamp reflector.

The main switchboard contains two transformer panels, two double-circuit feeder panels, one station panel and two blank panels. Concrete slabs are used in the low-tension bus and oil-switch structure, the cells in the sub-structure containing the oil switches and the bus-bars being housed in compartments above these. The bus-bars are cut into two sections by an oil circuit-breaker; and each section may be further divided by means of selector switches. The bus-bars are connected to the low-tension side of the step-up transformers by means of two 1,000,000-circ. mil lead-covered cables per phase.

The high-tension transformer leads are taken through wells in the floor of the second story and connect through oil switches to the high-tension busses or feed direct to the line. The current for operating the high-tension circuit-breakers is obtained from oil-insulated series transformers. Oil-insulated choke coils are placed between the transformers and the oil switches to relieve the former of the strains due to surges in the line. Lightning arresters of the single-pole, low-equivalent type are installed.

Four sets of outgoing lines are used for distributing the energy, a double steel tower being used for supporting this line. This line was described in the May 23 issue.

Besides the Great Falls station, the Southern Power Company has ordered six 5200-hp and one 700-hp twin horizontal turbines, which will be exact duplicates of the Great Falls turbines for the new Ninety-Nine Island station. This station will be located on the Broad River nine miles above Blacksburg, S. C. Work is now being pushed on this development and everything will be rushed as rapidly as possible to completion. The other developments will be taken up in order and completed as rapidly as possible.

When all of the developments of this company are completed they will have carried out not only the largest power scheme in the South, but one of the largest in the world.

Notes on the Parallel Operation of Alternators.

BY WALDO V. LYON.

When two alternating-current generators are operating in parallel there will frequently exist a certain "cross" or "interchange" current between the machines, which may be harmful or useful depending upon the condition from which it arises. It is the purpose of this article to discuss as fully, and yet as simply as possible, the cause and effect of this interchange component of the armature current. Although the discussion will be limited to the case of two identical alternators, the methods used are perfectly general in their application. The results, however, are more easily attained and, since they illustrate the salient features of the problem as well, the complication introduced by considering the general case does not seem warranted. Furthermore, the work is applied to single-phase alternators or to one phase of polyphase machines with balanced loads. In the latter case the machine constants are taken for one phase between line and neutral. If the alternator is mesh-connected it must be reduced to the equivalent star-winding. The discussion has all of the limitations that are inherent in the synchronous impedance method for calculating the regulation of alternators.

Let us suppose that at some instant the induced e. m. f.s of the

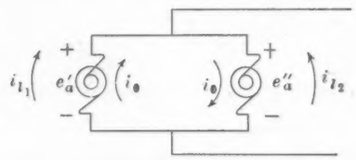


FIG. 1.—ARRANGEMENT OF ALTERNATORS.

two alternators are e'_a and e''_a, and that their signs are as indicated in Fig. 1. It is then evident that in going around the series circuit through the armatures there will be a resultant e. m. f., $e_e = e'_a - e''_a$ tending to send a current clockwise around the circuit; that is, in conjunction with e'_a, but in opposition to e''_a. Designate this interchange current by i_e, and the other component of the armature currents by i_{l_1} and i_{l_2}. The latter are the external components which are supplied to the load and are in conjunction with e'_a and e''_a, respectively. The total current in the armature of the first alternator will, therefore, be $i_1 = i_{l_1} + i_e$, while in the second it will be $i_2 = i_{l_2} - i_e$.

If the axis to which all vectors are referred in the common potential difference at the terminals of the alternators, the *vector equations* may be written by replacing these instantaneous values of currents and voltages by their corresponding *vector* values. Thus the vector equations are:

$$E_e = E'_a - E''_a$$

$$I_1 = I_{l_1} + I_e \qquad (1)$$

$$I_2 = I_{l_2} - I_e \qquad (2)$$

The external current is the sum of the armature currents, viz., $(I_1 + I_2)$.

When alternators are operating in parallel perfectly, that is, with no interchange current, their e. m. f.s are not only *in phase*, but also *equal* in *magnitude*, for if these two conditions do not exist there will be a resulting voltage $(E'_a - E''_a)$, which will produce an interchange component in the armature currents. In general, when there is an interchange component, the armature currents are not in phase with the external current.

Suppose that for some reason the armature currents become

displaced in phase and take up new positions, as shown by I_1 and I_2 in Fig. 2. The vector expressions for these currents are:

$$I_1 = i_1 + ji'_1 \text{ and } I_2 = i_2 + ji'_2$$

If this phase displacement of the armature currents is of a permanent nature the magnitude of the vector components of I_1 and I_2 may be experimentally determined with the proper instruments.

The induced armature voltage of each alternator is the potential difference at its terminals plus the armature impedance drop, so that the equations for these voltages will be:

$$\left.\begin{aligned} E'_a &= PD + (i_1 + ji'_1)\ (r + jx_a) \\ E''_a &= PD + (i_2 + ji'_2)\ (r + jx_a) \end{aligned}\right\} \text{ not shown in Fig. 2.}$$

The vector difference of these two voltages is the resultant e. m. f. acting in the series circuit through the armatures of the alternators; that is, $E_0 = E'_a - E''_a$ or $E_0 = (r + jx_a)[(i_1 - i_2) + j(i'_1 - i'_2)]$. In a circuit whose impedance is equal to that of the combined armature impedances of the alternators a certain current, I_0, would flow if a resultant e. m. f., E_0, were impressed upon it. The magnitude and phase of I_0 would be determined by the equation:

$$I_0 = \frac{E_0}{2r + j2x_a} = \tfrac{1}{2}[(i_1 - i_2) + j(i'_1 - i'_2)]$$

That is, the interchange component of the armature currents is always equal to one-half of their vector difference. The ex-

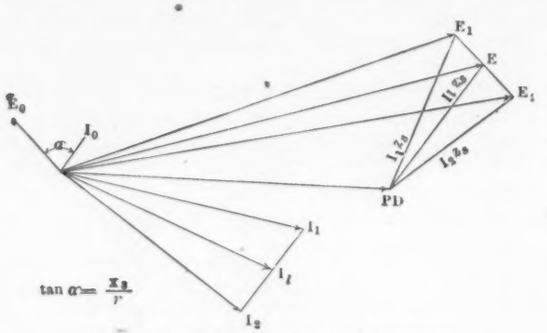


FIG. 2.— VECTOR DIAGRAMS OF CURRENTS.

pression for the external component of the armature current of the first alternator is given in equation (1), which, when written in its complete vector form, becomes:

$$(i_1 + ji'_1) - \tfrac{1}{2}[(i_1 - i_2) + j(i'_1 - i'_2)]$$

and this reduces to:

$$I_{l1} = \tfrac{1}{2}[(i_1 + i_2) + j(i'_1 + i'_2)] \qquad (3)$$

The vector expression for the external component of I_2 is the sum of the armature current and its interchange component; that is:

$$I_{l2} = \tfrac{1}{2}[(i_1 + i_2) + j(i'_1 + i'_2)] \qquad (4)$$

The current in the external circuit is the vector sum of the armature currents and is:

$$I \text{ external} = [(i_1 + i_2) + j(i'_1 + i'_2)] \qquad (5)$$

Equations (3) and (4) show that the external components of the armature currents are in phase and that one is equal to the other, and equation (5) shows that these external components are also in phase with the external current.

Since there are no necessary assumptions made concerning the cause of this result other than the equality of armature resistances and of armature reactances, there are no limitations placed upon its application. Therefore, the currents in the armature may be separated for convenience into two components, and if the load supplied by the alternators is constant, one of these, the external component, is fixed both in magnitude and phase; and the other, the interchange component, is one-half of the vector difference of the armature currents. This holds for any and all possible conditions. Since the load components of the armature currents are always equal, they will hereafter be designated by: $I_l = i_l + ji'_l$. The total external current is $2I_l$.

It is very important to note that, though entirely logical, it is merely for convenience that the armature current is divided into these two components, and that neither of them exists independently. The simplification is that it is thereby possible to study the action of the two armature currents through the effects produced by their interchange component alone, for the *external components* are alike, both in *magnitude* and *phase*.

In the foregoing deduction of the interchange component the only assumption made was that the complex expressions for the armature impedances were identical. If the same holds true for the synchronous impedances they might equally well be used, the only effect upon the diagram being to replace the armature induced e. m. f.s by the fictitious voltages E_1 and E_2, which are the open circuit voltages for the given field excitations; also E_0 would equal $E_1 - E_2$. In all of the following work this substitution will be made since it gives a direct connection between the field excitation and the armature voltage.

There are a number of important relations that exist in this diagram, Fig. 2, which should be mentioned. The vector equation for the armature voltage of the first alternator is: $E_1 = PD + I_1 z_s$. Since $I_1 = I_l + I_0$, this may be written: $E_1 = PD + I_l z_s + I_0 z_s = E + I_0 z_s$. Likewise the armature voltage of the second alternator is:

$$E_2 = PD + I_2 z_s = PD + I_l z_s - I_0 z_s = E - I_0 z_s$$

That is, the synchronous impedance drop in each alternator may be resolved into two components, one of which is constant in magnitude and phase with respect to the terminal potential difference as long as the external component of the armature current is likewise constant, and the other depends upon the interchange current for its magnitude and phase. The vector E always bisects the difference between E_1 and E_2, viz., E_0. If the external circuit has a constant resistance and a constant reactance, the potential difference is proportional to the external current, and the phase relations of I_l and its component drop $I_l z_s$, with respect to the potential difference, are fixed. Since PD and $I_l z_s$ are proportional and the angle between them is constant, E will be proportional to have a fixed phase relation with the potential difference.

There are three distinct causes which will produce an interchange component in the armature current, but they all affect the armature voltages by changing their magnitudes or their phase relations. The first cause is an inequality in the field excitations; the second, an inequality in the power supplied by the prime movers, which occurs when the load is shifted from one to the other, and the third is a non-uniform angular velocity which is principally due to the action of the reciprocating parts and governors of the prime movers. All of these causes, however, produce one common effect, and that is that the combined heating loss in the alternators is increased, and if the interchange current is large, the additional heating may be so serious as to decrease their capacities. This heating loss, caused by the interchange component of the armature current, will be defined as the difference between the loss when there is an interchange component and when it is not present, provided, also, that the condition of the external load is fixed. When there is an interchange current the heating loss in the first alternator is: $[(i_l + i_0)^2 + (i'_l + i'_0)^2]r$. The normal heating loss is: $(i_l^2 + i'^2_l)r$. The heating loss caused by the interchange current is: $[(i_l + i_0)^2 + (i'_l + \overline{-}i'_0)^2 - (i_l^2 + i'^2_l)]r$. This reduces to the more convenient form: $I_0^2 r + 2r(i_l i_0 + i'_l i'_0)$. Thus, in general, the additional heating loss caused by the interchange current is not given by the usual expression for such a loss, viz., $I^2_0 r$, and it only reduces to this form when $\frac{i'_0}{i_0} = -\frac{i_l}{i'_l}$ — that is, when the interchange component is in quadrature with the external component.

Likewise the expression for the heating loss caused by the interchange current in the second alternator is:

$$I^2_0 r - 2r(i_l i_0 + i'_l i'_0) \qquad \text{(see equation 2)}$$

The additional heating loss in both generators is the sum of the individual losses, and this reduces to: $2I^2_0 r$.

Therefore, the total heating loss caused by the interchange current is given by the usual expression of the square of the current multiplied by the sum of the armature resistances. The heating loss is greater in one generator than in the other, except when the interchange component is in quadrature with

the external component of the armature current, in which case the losses are equal.

The first method of producing an interchange component in the armature currents is by changing the field excitations of the alternators. A diminution in the field excitation of the first tends to decrease its armature induced e. m. f. with respect to that of the second, and, as the system attempts to regain its former equilibrium, there is a force developed which opposes this relative reduction and tends to equalize these e. m. f.s. There is but one way in which this may occur, and that is through the effect of the armature reaction on the impressed field. It is well known that a leading armature current increases the resultant field, which is the direct cause of these induced e. m. f.s, and that a lagging current reduces it. Thus the natural reaction that follows a reduction in the field of one alternator is the production of a leading current in that armature which, because of its magnetizing action on the field, opposes the reduction. Furthermore, we saw that the external component of the armature current was fixed by the character of the load, and so this leading current must be the interchange component of the armature current. If the field excitations of the alternators are alone varied the division of the load cannot be changed, except by the small amount which is due to possible variation in the losses, and thus under this condition the interchange component of the armature current is practically wattless with respect to the potential difference. Therefore, the effect of a reduction in the field excitation is to produce an interchange component in the armature current which is wattless and leading, and which opposes the reduction by virtue of its magnetizing action on the field. Since the reaction developed tends to bring about an equality of the armature induced e. m. f.s, the effect on the other alternator must be that of an interchange component in the armature current which is wattless and lagging, and thus weakens the field. Because of this equalizing action the potential difference will not be reduced as much by a given change in the field of one alternator as it would be if the generators were not in parallel.

The extreme case in which one alternator loses its field excitation entirely is interesting. Under this condition the resultant field is in phase with the armature current, since it is due to the effect of armature reaction alone, and thus the armature induced e. m. f., which is always in quadrature with the field producing it, is in quadrature with the armature current. The electromagnetic power developed by this alternator is zero and the entire load, as well as all of the losses, is supplied by the other. The resulting potential difference, which is probably somewhat more than one-half* its initial value, is used wholly in synchronous impedance drop in the first alternator, and the current is very large and leads the potential difference by slightly more than 90 degrees. In the second alternator the armature current is also very large, but lags behind the potential difference. The effect of a large armature reaction would be to increase the synchronous reactance, and with generators of this type the currents would not reach such high values.

When one alternator loses its field excitation and its ability to take any share of the load, the two generators cannot be working at the same point on their mutual speed-load characteristic. Furthermore, since the induced e. m. f. is always in quadrature with the armature current, there can be no synchronizing action to increase the load on this generator when its speed increases. Since, however, the resultant field is due to the armature reaction alone, its speed of rotation with respect to the armature conductors is determined solely by the frequency of the armature current, and this is supplied from the second alternator. Thus the frequencies of the induced e. m. f.s are the same, and are independent of the speed of the first prime mover. Therefore, if the field circuit of the first alternator is opened, the entire load is removed from its prime mover, and its speed increases to at least the no-load value. The currents in each alternator will greatly exceed their normal value due to the large interchange component which is produced.

*Theoretically it is one-half.

A shifting of the load from one alternator to the other will always cause an interchange component in the armature currents, since the external components are equal. The load shifted from one machine to the other is given by the expression:

$$I_0 \times PD \times \cos \angle^{I_0}_{PD}$$

The phase relationship of the interchange component may then be adjusted by varying the field excitations. We have seen that whenever there is an interchange component the combined heating loss in the alternators is increased. The loss will be a minimum when the interchange component is a minimum, and, for a given change in the load, this occurs when it is in phase with the potential difference. Thus, when the load has been shifted from one alternator to the other, the best condition, as far as heating is concerned, is not when the armature currents are in phase with the external current unless the power-factor of the load is unity. Whenever two identical machines are not delivering equal loads there is an interchange component in their armature currents and the total heating loss in both is greater than which they divide the load equally.

The third and most important cause which produces an interchange component in the armature current is the non-uniform speed of the prime movers. A complete discussion of the speed variation of prime movers is beyond the scope of this article, and it is sufficient to say that the relative angular acceleration of one of the alternators will produce a phase displacement of the armature voltages E_1 and E_2. Since these are the voltages corresponding to the constant impressed fields, the relative displacement of the armature conductors is equal to the displacement of

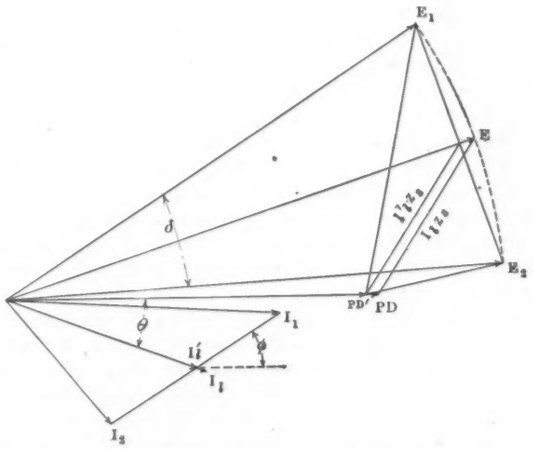


FIG. 3.—LOAD DIAGRAM.

the voltages. At the instant when the first alternator, which has accelerated with respect to the other, has reached the point of maximum displacement and is about to retard its motion, the speeds of the two alternators are the same and the voltages E_1 and E_2 are numerically equal. The following equation may then be written:

$$(PD' + i_1 r - i'_1 x_s)^2 + (i_1 x_s + i'_1 r)^2 = (PD' + i_2 r - i'_2 x_s)^2 + (i_2 x_s + i'_2 r)^2$$

(See Fig. 3.)

Expand each side of this equation and collect the terms:

$$(i_1 - i_2)\,[2rPD' + (i_1 + i_2)\,z_s^2] = \ldots$$
$$\ldots (i'_1 - i'_2)\,[2x_s PD' - (i'_1 + i'_2)\,z_s^2] \qquad (6)$$

but, $(i_1 - i_2) = 2i_0$, $(i'_1 - i'_2) = 2i'_0$,

also $(i_1 + i_2)$ and $(i'_1 + i'_2)$ are the power and wattless components of the external current. Equation (6) may be written in the form:

$$\frac{i'_0}{i_0} = \frac{rPD' + z_s^2 i_l}{x_s PD' - z_s^2 i'_l} \qquad (7)$$

Let X be the total reactance of the load, R the total re-

sistance and Z the total impedance. If numerator and denominator of equation (7) are multiplied by $\frac{Z}{2\sqrt{i_l^2+i'_l{}^2}}$ it will reduce to a more convenient form:

$$\frac{i'_0}{i_0}=\frac{2Z^2r+Rz_s^2}{2Z^2x_s+Xz_s^2}=\tan\phi.$$

The sign of the second term in the denominator is changed for the reason that if i'_l is positive the external current leads the potential difference while it is customary to assign X a negative value for a capacity load. It will be observed that the phase relation of the interchange component with respect to the terminal potential difference is fixed by the character of the load.

In general, if the vectors E_1 and E_2 are equal, their resulting difference $E_0=E_1-E_2$ leads their sum (E_1+E_2) by 90 deg. The vector (E_1+E_2) is in phase with the initial armature voltage E and since I_0 lags behind E_0 by the $\tan^{-1}\frac{x_s}{r}$ it must lead E by the $\tan^{-1}\frac{r}{x_s}$. (This is a small angle, probably never greater than 8 deg.) It is then evident from Fig. 3 that for all ordinary conditions the projection of I_0 on PD is positive. Since the vector expressions for the armature currents are $I_1=I_l+I_0$ and $I_2=I_l-I_0$ the effect of the interchange current, when thus brought about by the variations in the speed of the prime movers, is to increase the load on the first alternator, which accelerates, and to decrease that on the other. The power component of the interchange current with respect to the terminal potential difference, which is alone responsible for this automatic shifting of the load, will be defined as the synchronizing current. Neglecting the losses in the alternators, which are usually not equal,* this definition of the synchronizing current gives a measure of the increase in the load on the first and the decrease on the second, which tends to bring the electromotive forces E_1 and E_2 into phase again. This is not the most common definition. Usually the wattless component of I_0 with respect to E_0 is called the synchronizing current. The reasons assigned are: that with respect to the armature voltages E_1 and E_2 it produces equal and opposite reactions on the alternators, increasing the load on the one which accelerates and decreasing that on the other; and that the other component of the interchange current produces the same reaction on each, viz., increases the load. But this definition of the synchronizing current can give no idea of the real amount by which the load on one alternator is increased and that on the other diminished, for it takes *no* account of the possible change in power due to the load components of the armature currents. These load components are equal and fixed in phase with respect to the potential difference. If as in Fig. 3 the load is inductive and E_1 leads E_2, as has been assumed, the power due to the load components of the armature currents and the respective electromotive forces is decreased for the alternator which accelerates and increased for the other. This is the opposite effect produced by the interchange current and under certain conditions the net change on the load might be zero. For example, if the interchange current is produced by the variation of the impressed fields alone, it is wattless with respect to the potential difference and has no synchronizing effect whatever. Therefore it seems more logical to define the synchronizing current as the power component of the interchange current with respect to the potential difference, provided that the interchange current is not produced by varying the power supplied by the prime movers, for then the conditions of operation are permanently altered by shifting the speed-load characteristics of the prime movers.

The vector diagram which applies to this case is given in Fig. 3. It should be noted of this diagram that as E_0 is always bisected by E it is perpendicular to it, since E_1 and E_2 are numerically equal. The component of the armature impedance drop due to the interchange current, I_0z_s, is $E\sin\frac{\delta}{2}$ where δ is the angular displacement between E_1 and E_2. It will be seen that the resulting terminal voltage is reduced in the ratio of 1 to $(1-\cos\frac{\delta}{2})$, and thus the variations in the speed will cause fluctuations in the potential difference, though in general they will be quite small.

The synchronizing current is $I_s=\frac{E\sin\frac{\delta}{2}}{z_s}\cos\phi$ This expression may be simplified by substituting for E and $\cos\phi$ their values in terms of the constants of the alternator and of the external circuit.

$$E=[(PD+i_lr-i'_lx_s)^2+(i_lx_s+i'_lr)^2]^{\frac{1}{2}}$$

E, PD, i_l and i'_l are the normal values of the voltages and the power and the wattless components of the armature current before there was an interchange component. Expand the quadratic expression under the radial sign and collect the terms:

$$E=[PD^2+I_l^2z_s^2-2PD\,(i_lr-i'_lx_s)]^{\frac{1}{2}} \qquad (8)$$

$$I_l=\tfrac{1}{2}\frac{PD}{Z}$$

$$i_l=\frac{R}{Z}I_l=\frac{R}{2Z^2}PD$$

$$i'_l=-\frac{X}{Z}I_l=-\frac{X}{2Z^2}PD$$

Substitute these values in equation (8) which then reduces to:

$$E=\frac{PD}{2Z}\sqrt{4Z^2+z_s^2+4(Rr+Xx_s)}$$

The value of $\cos\phi$ may be obtained from tangent ϕ:

$$\cos\phi=\frac{2Z^2x_s+Xz_s^2}{Zz_s\sqrt{4Z^2+z_s^2+4(Rr+Xx_s)}}$$

The synchronizing current reduces to:

$$I_s=PD\left(\frac{x_s}{z_s^2}+\frac{X}{2Z^2}\right)\sin\frac{\delta}{2} \qquad (9)$$

It should be observed that this simplified expression for the synchronizing current is only true when the impressed fields are such as to give equal armature voltages, that is, $E_1=E_2$. PD is the normal potential difference.

The maximum angular displacement of the armature (δ) depends upon the mechanical construction of the moving parts, the action of the governor and other things of more or less indeterminate effect, so that its discussion is too complex to be attempted in this brief article. It is interesting, however, to note the effect upon the synchronizing current of the other factors, viz., z_s, X and R.

The interchange current is $I_0=\frac{E\sin\frac{\delta}{2}}{z_s}$. It does not depend upon the character of the load although its synchronizing component does. With alternators which regulate very well on moderate power factors, x_s being usually small, the interchange current is large for a given relative angular displacement of the armatures, and the increased heating loss thus incurred may be great enough to considerably decrease their capacities. Thus very close regulation may have a serious disadvantage when alternators are operated in parallel.

For any given load condition the synchronizing current is a maximum when $\frac{\delta I_s}{\delta x_s}=0$. A solution of this equation shows that for the maximum synchronizing current $x_s=r$ (a very small value of x_s since in actual practice it may be from 10 to 20 times as great as r). Consequently a small synchronous impedance is favorable in that it increases the synchronizing power of the alternator.

For constant current output, that is, with Z constant, inspection of equation (9) shows that the synchronizing current is greatest when X is positive (inductive load) and equal to Z (X cannot be greater than Z), and that it is least when X is negative (capacity load) and equal to Z, that is, alternators operate in parallel better on an inductive load. When X is

*They are only equal near zero power factor on an inductive load.

zero, that is, on unit power factor, the synchronizing current is independent of the load and is the same as on open circuit.

The effect of the character of the load upon the parallel operation of two alternators may be quite forcibly shown by an example. The constants (per phase) of a 150-kw, 60-cycle, two-phase, 230-volt alternator are $r = 0.0172$ and $x_s = 0.354$; r may be neglected since it is but about 5 per cent of x_s. Let us suppose that two such machines will operate satisfactorily on an 85 per cent power factor inductive load of 326 amperes. Under this condition:

$$I_s = PD\left[\frac{1}{0.354} + \frac{0.181}{2\times(0.353)^2}\right] sin\,\frac{\delta}{2}$$

$$= 3.55\,PD\,sin\,\frac{\delta}{2}$$

$$\left[\begin{array}{l} Z = \dfrac{230}{2\times 326} = 0.353\,ohm \\ X = 0.527\times 0.353 = 0.181\,ohm \end{array}\right]$$

Suppose that there is now thrown on these machines a condensive load requiring full-load current from each at 50 per cent power factor

$$I_s = PD\left[\frac{1}{0.354} - \frac{0.306}{2\times(353)^2}\right] sin\,\frac{\delta}{2}$$

$$= 1.59\,PD\,sin\,\frac{\delta}{2}$$

$$\left[X = 0.306\,ohm\right]$$

That is, for the same angular variation in the relative positions of the armatures of the alternators, the synchronizing current has been reduced to 45 per cent of its former value. If the mechanical characteristics of the prime movers require a certain synchronizing torque to keep the alternators in step this relative angular displacement must increase to considerably more than double its former value (under inductive load) before the necessary reaction is developed. This increased allowable swing may be extremely undesirable or even dangerous if there are accumulative effects due to mechanical resonance. The fluctuations of the terminal voltage will be much greater and of probably a longer periodicity.

It might even be possible to put the alternators on such a heavy condensive load that the synchronizing current would no longer act to keep the machines in step but would actually tend to make them run in series. From equation (9) it will be seen that the necessary condition that this may occur is that $\frac{X}{2Z^2} > \frac{x_s}{z_s^2}$, for this makes I_s negative and so its effect is to reduce the load on the alternator which accelerates. Since R equals zero and r may be neglected this reduces to the condition that the total reactance of the load must be less than one-half of the synchronous reactance of the alternator. If this result is applied to the alternator under consideration we shall find that it is necessary to put the machines on a condenser load that takes more than 650 amperes per phase from each generator —about 200 per cent of full-load current—before the synchronizing current acts in this peculiar manner.

It is also interesting to note the effect of inserting capacity in the bus-bars between the machines. For a given load the synchronizing current is determined by the constants of the armature circuit. The synchronizing current is maximum when x is inductive reactance and equal to r (as we have already seen) and is minimum when x is capacity reactance and equal to r. When x is zero the synchronizing current depends solely on the constants of the external circuit. It would be zero only on unit power factor. For an inductive load it would have a true synchronizing effect, while on a condensive load the alternators would tend to run in series. Thus the effect of inserting capacity reactance in the armature circuit would first be to increase the synchronizing current to a maximum value. Beyond this it would fall off very rapidly and would be zero—if X were zero—when the capacity reactance was equal to the sum of the synchronous reactances of the alternator. A still further increase in the capacity reactance would tend to make the machines run in series.

The Most Economical Shape of Winding for Electrical Measuring Instruments.

BY A. P. YOUNG.

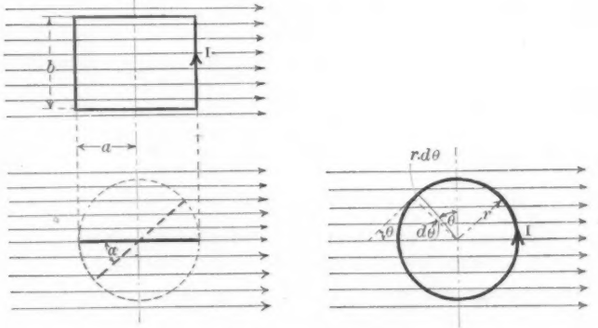
In electrical measuring instruments it is desirable that the ratio of torque to weight of moving element should be as large as possible, for in this way the effect of friction in the moving system is reduced and any inaccuracies due to this cause are greatly diminished.

Taking, for example, the case of a wattmeter or watt-hour meter, there is, in general, a movable coil of fine wire carrying a current proportional to the supply voltage, which moves in a magnetic field produced by coils which carry the main current. Of course, for given conditions the torque exerted on the movable coil could be increased by increasing the number of turns on the stationary winding or by increasing the ampere-turns on the movable coil; that is, by increasing either the turns on this coil or the current in the coil. Increasing the number of turns means a larger and more expensive winding, while increasing the shunt current (that is, the current in the movable coil) results in an increased loss of energy in the shunt circuit, which, of course, is undesirable. Supposing, however, that values have been chosen for the three factors, namely, (1) number of turns in the main winding, (2) number of turns in the movable coil, (3) shunt current, then the question will arise as to what shape of movable coil will give the greatest torque, using a certain length of wire, or, in other words, what shape of movable coil will give the greatest ratio of torque to weight of wire used.

In the following, consider a coil of only one turn, which is free to move in a magnetic field of constant and uniform density. Consider first the case of a rectangular winding, such as is shown in Fig. 1. Let

Current carried by coil $= I$.
Intensity of magnetic field $= B$.
Length of coil $= 2a$.
Breadth of coil $= b$.

Then when the plane of the coil is parallel to the magnetic



FIGS. 1 AND 2.—TORQUE FOR RECTANGULAR COIL AND FOR CIRCULAR COIL.

lines, the coil is in the position for maximum torque and, thus, in c. g. s. units the torque corresponding to this position is $2abBI$. If the coil is now rotated through an angle α, the torque corresponding to this new position is $2abBI\cos\alpha$. Therefore, the average torque corresponding to a variation of

$$\alpha \text{ from } +90^\circ \text{ to } -90^\circ = \frac{2abBI}{\pi}\int_{-\frac{\pi}{2}}^{+\frac{\pi}{2}} cos\,\alpha.d\alpha$$

$$\text{that is, average torque} = T = \frac{2abBI}{\pi}\Big[sin\,\alpha\Big]_{-\frac{\pi}{2}}^{+\frac{\pi}{2}}$$

$$T = \frac{4abBI}{\pi}$$

Denoting the total length of the wire by l

$$2b + 4a = l$$

$$b = \frac{l}{2} - 2a$$

Therefore, $$T = \frac{4BIa}{\pi}\left(\frac{l}{2} - 2a\right)$$

$$T = \frac{2BI.la}{\pi} - \frac{8BI.a^2}{\pi}$$

If l is kept constant and as a is varied:

$$\frac{dT}{da} = \frac{2BI.l}{\pi} - \frac{16BIa}{\pi}$$

T will be a maximum when $\frac{dT}{da} = 0$. Therefore, the value of a corresponding to the maximum value of T is given by the equation:

$$\frac{2BI.l}{\pi} = \frac{16BIa}{\pi}$$

that is. $l = 8a$.

This means that b must equal $2a$, or, in other words, the section of coil must be square. The average value of the torque corresponding to a square section is given by $\frac{2BIb^2}{\pi}$

Consider next a circular coil. Referring to Fig. 2, assume that the coil is in the position for maximum torque; that is, the plane of the coil is parallel to magnetic lines. Considering an element of the coil, $rd\Theta$.

Torque exerted on element $= BIr^2 d\Theta \sin^2\Theta$

Torque exerted on whole coil $= 2BIr^2 \int_0^{\pi} \sin^2\Theta . d\Theta$

$$= 2BIr^2\left[\frac{\Theta}{2} - \frac{\sin 2\Theta}{4}\right]_0^{\pi}$$

$$= BI\pi r^2$$

The average value of the torque corresponding to a movement of the coil between 90° displacements on either side of the position considered, is given by,

$$\frac{2}{\pi} . BI\pi r^2 = 2BIr^2 \qquad (1)$$

The length of wire used to produce this torque is

$$l = 2\pi r$$

If this length of wire is wound so that the section is a square, then length of side $= b = \frac{\pi r}{2}$

Average value of torque $= \frac{2BIb^2}{\pi} = BI.r^2\left(\frac{\pi}{2}\right)$ (2)

That is, using the same length of wire,

$$\frac{\text{Average torque exerted by circular coil}}{\text{Average torque exerted by square coil}} = \frac{4}{\pi}$$

or the circular coil gives approximately 27 per cent greater torque than a coil of square section, using the same length of wire in each case, and assuming that the magnetic field in which the coil moves is uniform.

This conclusion is interesting and is probably of greatest practical importance as applied to the case of a watt-hour meter of the commutator type. An instrument of this type consists of a rotating armature made up of a number of coils such as have been assumed above, and the torque exerted by this armature is proportional to the average value of the torque exerted by each coil. The foregoing conclusion shows that in such cases the spherical drum form of armature is the most economical.

In the case of permanent magnet instruments, where there is a rectangular coil moving in a radial magnetic field of permanent value, the torque is dependent solely on the current passing through the coil and independent of the angular position of the coil. For such instruments it is readily seen that the square form of coil is the most economical, which means that for an instrument of this type the square section of coil gives the greatest torque for certain values of the magnetic strength, moving-coil turns, moving-coil current and length of wire used.

A Composite Telegraph and Telephone System for Interurban Railways.

The Interurban Railway Company, of Des Moines, Iowa, has been testing, for the past year, a combined dispatching and commercial telegraph and telephone system that has many new and novel features. The system is being tried out on the Beaver Valley Division of the company's lines. On this division cars were originally dispatched by a single telephone line consisting of a single metallic circuit of No. 9 BB galvanized iron wire, carried on 35 ft. poles directly underneath a 25,000-volt, three-phase, high-tension line for a distance of about 40 miles.

On this single metallic line there are connected about 20 bridging local battery telephones, a telephone being located at each station and passing point on the main and branch or junction line.

Owing to the large amount of freight and express handled on this branch it was found necessary to either erect another telephone line or install a system of telegraph instruments on the existing telephone line. The latter was found to be the cheaper, and thought to be the better plan, since the telegraph is more reliable and better suited for certain classes of work than the telephone. The telegraph instruments were first connected as shown in Fig. 1, which illustrates the usual method of connecting telegraph instruments in series on a composite telegraph and telephone line. Since both sides of the telephone line are used as one side on the telegraph line, it is necessary at each intermediate telegraph station to cut a condenser in each side of the telephone line to open the line to the direct-current telegraph current and shunt it through the telegraph instruments. In using the telephone it is necessary to signal and talk through these condensers, and while they do not interfere with the small undulating voice currents used in talking, they do seriously interfere with the magneto signaling currents, especially where there are a large number of telephones used on the line. Aside from the expense of maintaining these troublesome condensers, it was found practically impossible to signal through them when six or eight intermediate telegraph stations were installed, as it was necessary to signal through eight or ten condensers in series. It was also found to be impossible to cut the telegraph instruments on the branch or junction line in series with those on the main line without installing another line wire on the branch line. To overcome these difficulties, and to secure other very desirable results, a method was devised of connecting the telegraph instruments in multiple. The three-point open circuit telephone keys are bridged onto both sides of the telephone line through balanced-wound impedance coils having three terminals. The end terminals are connected to the telephone line. The telegraph keys are connected between the middle point of the impedance coil and some source of direct-current supply, as illustrated in Fig. 2. The relays are bridged on in multiple with each other and with the keys between the middle terminal of this same impedance and grounded through about 1000 ohms of non-inductive resistance, X and Y; the object of the resistance X being to give an even distribution of energy through all the relays on the line when sending or receiving. It will be observed that resistance X, Fig. 2, is shunted out when receiving, and cut in when sending. When resistance X equals the combined resistance of the line and two impedance coils, the relays at each telegraph station will get the same amount of energy when receiving as when sending. The resistance "Y" also aids in obtaining an even distribution of energy to all the relays on the line by decreasing the per cent that the line resistance, which is a variable amount between each telegraph station, bears to the total resistance of any multiple telegraph circuit. Since the 500-volt railway circuit is usually available at all telegraph stations on interurban dispatching lines this affords a very convenient and reliable method of obtaining energy by connecting the key in between the middle terminal of the impedance coil and four or five 16-cp lamps in series, as illustrated in Fig. 2, so as to obtain 110 volts on the telephone line.

For the fifth or ground lamp it is best to use four 16-cp lamps in series multiple as illustrated in Fig. 2. With this combination there is no danger of the lamps burning out and throwing current at 500 volts potential on the telegraph line. The local sounder is connected in the usual manner, either with local battery, which, in this case can be ordinary dry batteries, since the sounder is on open circuit when not in actual use, or by shunting the ground lamp in a series of five. After a test covering a period of one year, it has been demonstrated that the

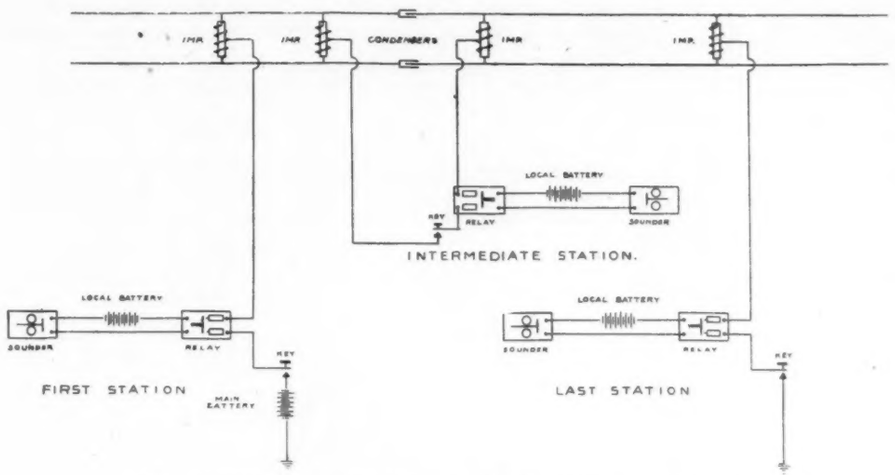


FIG. 1.—DIAGRAM OF CONNECTIONS OF TELEGRAPH INSTRUMENTS.

above-described method of connecting telegraph instruments on the open-circuit multiple method on combined telegraph and telephone lines for interurban service has several well defined advantages over the series or closed circuit method. Energy is not being used except when keys are in actual use. All stations are independent of each other, and any one can be cut on or off the line at any time without interfering with the rest of the line. A break or opening in the instruments of one station does not affect the other stations on the line. It is impossible for an operator to go away and leave the line open by leaving his key open. The operator can cut his instrument off the line by opening the double-pole switch, Fig. 2, and practice without interfering with the rest of the service. If both sides of the telephone line should break, telephone service can still be maintained on each side of the break without making any changes in the instruments or the line. With the multiple or open-circuit system the telephone line does not have to be cut or changed in any manner and portable instruments can be plugged on or off the line the same as portable telephone instruments, as illustrated in Fig. 6.

It is very convenient in reporting accidents, break-downs, and trouble on the line, where you do not wish the passengers and general public to hear, as they would if the telephone was being used. The multiple or open-circuit system requires no condensers and but one impedance coil at each station; whereas, the series closed-circuit system requires two condensers cut into the telephone line and two impedance coils cut across the line at each intermediate telegraph station.

Probably the greatest advantage of the multiple system over the series system in operating a combined telegraph and telephone line which parallels a high-tension line results from the system of connecting the balanced-wound impedance coil to line through relays and through resistance to ground. Figs. 3, 4 and 5 show different kinds of balanced-wound impedance coils which may be used.

Both sides of the telephone line being of the same potential no telegraph curent will pass from one side to the other through the telephones bridged onto the line, and, therefore, will in no way interfere with the telephone service. The great trouble with the telephone for dispatching purposes, especially when the telephone line parallels high-tension lines, is due to the extreme sensitiveness of the telephone receivers to the slightest trace of alternating current or a varying current of any description.

A well constructed telephone line must have the same resistance, impedance, inductance and capacity in each side of the line; not only must each side total the same, but each side must have the same between each talking station. The line must be so transposed that each side of the circuit shall occupy and travel in the same zone or position relative to all source of inductance half of the distance between each talking station.

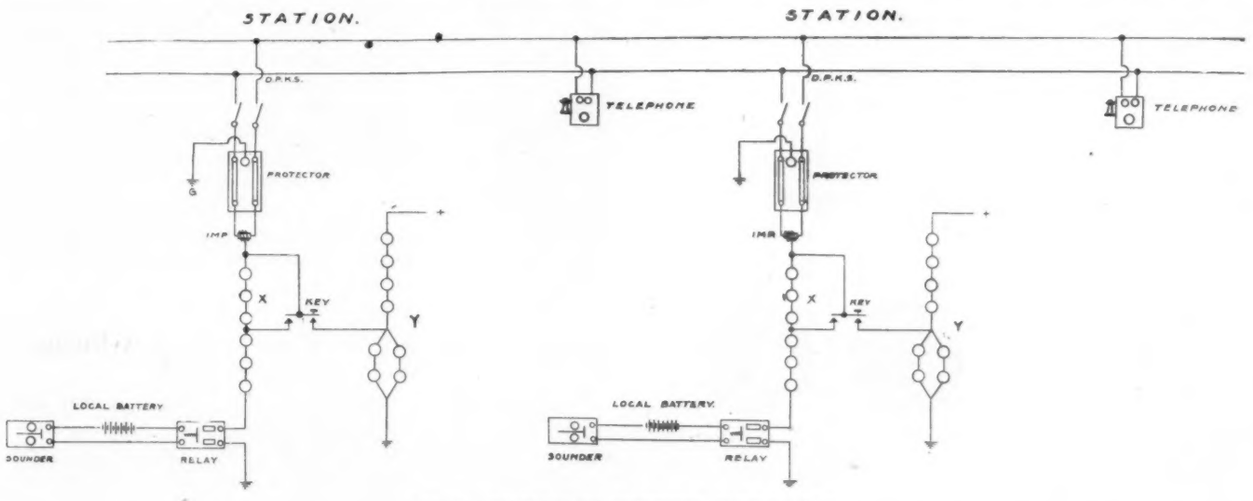


FIG. 2.—DIAGRAM OF COMPOSITE CONNECTIONS.

The line must be properly insulated not only from other lines, but from the ground and all other objects having capacity which would unbalance it. The greatest source of trouble in operating dispatching lines which parallel high-tension lines and the one most difficult to overcome arises from the compromising position the telephone line is made to occupy to satisfy two opposite and opposing conditions. One for the purpose of keeping the line clear of the ground, and the other for the purpose of preventing a high difference of potential from arising between both sides of the line and ground, which might be induced from

the high-tension line, or from some foreign line coming in contact with the telephone line. To satisfy one condition the line must be kept perfectly insulated and clear of the ground. To satisfy the other condition it must be brought near the ground in many places so that the striking distance is within the range of safe and moderate voltages. To accomplish this result the line must be brought within 1/100 of an inch of the ground in many places. The devices ordinarily used for this purpose consist of two carbon plates separated about 1/100 of an inch by perforated celluloid or mica, one carbon plate being connected

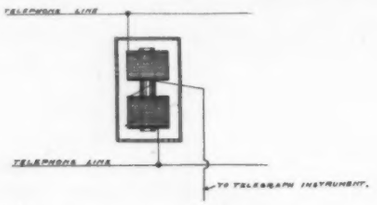
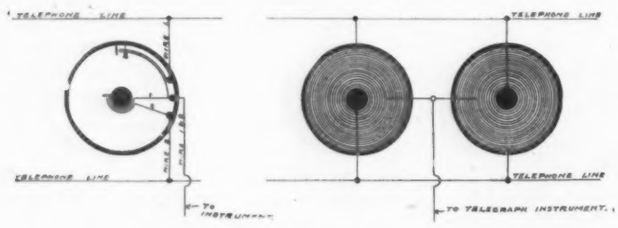


FIG. 3.—IMPEDANCE COIL.

to one side of telephone circuit and the other carbon plate connected to the ground. When a discharge takes place from one carbon plate to the other, it burns and blisters it and leaves that side of the line permanently grounded. The capacity of the grounded side is greatly increased, the telephone line becomes unbalanced, and so noisy as to become inoperative to telephone service.

It is then necessary to go over the line and clean the protectors. Dust and dirt also accumulate on these protectors with the same result. The installation of multiple telegraph instruments on telephone lines of this character overcomes most of the above mentioned trouble. The grounding of the neutral point of the impedance coils through the relays and non-inductive resistance serves to carry off the static and other stray electricity which otherwise would accumulate and discharge across the carbons and blister them. Thus, the installation of the telegraph instruments on the same line as the telephone, instead of introducing any new or increased complications or troubles, greatly diminish the existing ones. Since the installing of the telegraph instruments on the Beaver Valley dispatching line nearly all the trouble arising from blistered carbons in the protector has been eliminated. This leads to the conclusion that when telephone instruments are not needed, both sides of the telephone line, paralleling high-tension lines should be grounded through suitable balanced-wound impedance coils. But wherever the business on the line is important enough to warrant the expense, telegraph instruments should be installed.

A composite system not only doubles the amount of business that can be handled over a single line, but is much more re-



FIGS. 4 AND 5.—IMPEDANCE COILS.

liable and convenient than either telegraph or telephone line alone. The telegraph and telephone are not both subject to the same troubles. Although the telephone is more sensitive to both atmospheric disturbances and induced currents from other lines, and consequently is less reliable than the telegraph, it is more convenient and better adapted for handling certain classes of business than the telegraph. For reporting cars, at passing points, and places where there are no operators, for communications between sub-stations and main stations, and all lines of business where it is necessary to get into close touch with each other, and where a quick and immediate response is required, and where one does not wish to talk through a second party, the telephone is unsurpassed.

There is sometimes a great deal of satisfaction in talking directly to the train crews, station attendants and other employees. For such work the telephone is most desirable. There are, however, times when a personal interview is not required and, perhaps, not wanted, and in such cases the telegraph has its advantages. The greatest trouble with the telephone for dispatching purposes is that the operating current is so small that the lines easily pick up sufficient foreign and induced current to interfere with the operating current, consequently the telephone instruments are very noisy. Telephone transmitters usually operate on from two to four volts, and as their resistance is

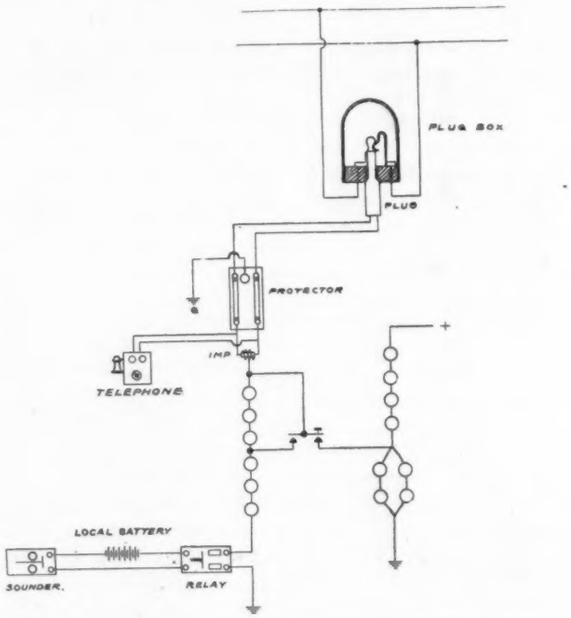


FIG. 6.—DIAGRAM OF PLUGGING-IN ARRANGEMENT.

from 10 to 20 ohms, they do not usually require more than one watt. This is a very small amount of power. If a transmitter could be designed to operate on 100 watts or more, the receivers could be made less sensitive to current from foreign lines, and would not be so affected by atmospheric conditions. The composite system has all the advantages of both systems with very little additional expense. It introduces no new troubles or conveniences and greatly diminishes the liability of total interruption of services. We are indebted to Mr. F. R. Cunningham, electrical superintendent of the Des Moines ty & Interurban Railways, for the information contained in this article.

Vertical Shaft Rotary Converter at Chicago.

The Commonwealth Edison Company, of Chicago, has just installed in its Market Street sub-station the first vertical shaft rotary converter to be put in operation in an American central station. The same company has already in use five 2000-kw vertical shaft motor-generator frequency changers, which are very satisfactory. The frequency changers have step bearings similar in principle to those on the Curtis steam turbine; the weight of the bearing being carried on a film of oil or water forced under the bearing. The rotary converter under consideration, however, differs considerably in construction from the frequency changer sets. It is a 2000-kw General Electric machine running at a speed of 166 r. p. m. Provision is made for carrying the weight of the revolving armature either on a roller bearing or on an oil pressure bearing. The roller bearing has given good results in factory test runs, and it is confidently expected that it will be the form of bearing finally adopted.

To provide for operation, should changes be necessary during the perfecting of the roller bearing, however, an oil bearing, interchangeable with the roller bearing, has been provided, together with a set of pumps for maintaining the pressure in the oil bearing. Fig. 2 is a vertical sectional drawing showing the relation of parts. The armature of the machine revolves about a stationary central shaft or pivot, such as shown in Fig. 4. This stationary shaft, which is 23 ins. in diameter, carries on its upper end the interchangeable roller or oil pressure bearing. The armature is mounted on a sleeve which revolves outside of the stationary shaft. The weight of this sleeve and the armature which it carries is taken by the bearing at the upper end. To get at the roller bearing, it is only necessary to remove a steel cap from the upper end of the revolving sleeve, after having first relieved this steel cap of the weight of the armature and sleeve by means of screw-jacks. These screw-jacks, which are a permanent part of the machine, consist simply of a set of screws which are accessible from the basement below the machine.

The field magnet structure, carrying 18 poles, is supported on cast-iron pillars resting on a concrete base ring, as shown in Fig. 3. To keep the revolving armature in line, there are two guide bearings, each 14 ins. long, below the roller bearing. To change from roller bearing to oil pressure bearing, it is a simple matter to take the weight off the top bearing, withdraw the cap screws holding the top plate and change from a roller to oil pressure bearing or vice versa.

The advantages of the vertical shaft rotary converter are many. There is a saving of about 17 per cent of weight in the vertical shaft machines, as compared with the horizontal shaft machines this company has in service. The horizontal shaft machines, to be sure, run at a lower speed, but they have been the only ones available, so that leaving out of account the questionable possibility of building satisfactory higher speed horizontal shaft machines, there is an important reduction in weight by the vertical shaft construction. One of the most important advantages of this construction is the accessibility of the brushes. The brushes on the vertical shaft machine are

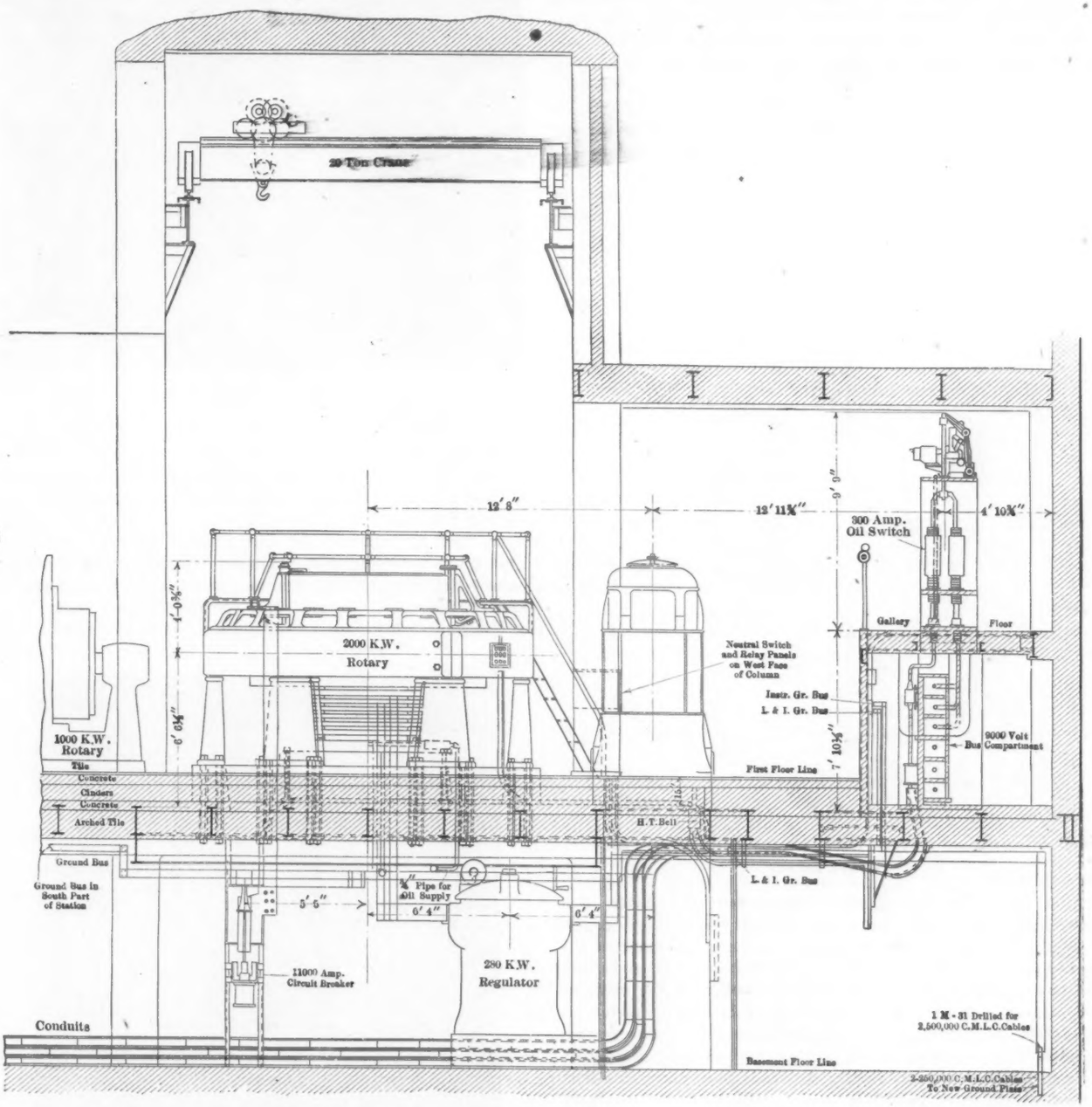


FIG. 1.—SECTIONAL ELEVATION SHOWING 2000-KW ROTARY EQUIPMENT IN MARKET STREET SUB-STATION OF THE COMMONWEALTH EDISON COMPANY.

readily accessible to an attendant on a platform extending around the machine and resting just above the field poles. On a horizontal shaft machine the attendant must climb ladders in difficult positions. The weight of the vertical shaft, 2000-kw machine is stated to be about 67 tons. The diameter of the circular floor space occupied by it is 15 ft. 3 ins. The height above the floor is 9 ft. 3 ins. The 2000-kw horizontal shaft machines of the company occupy a floor space of 16 ft. 6 in. x 16 ft. 6 in., and extend 12 ft. 11 ins. above the floor and 3 ft. 7 ins. below, making the total over all height 16 ft. 6 ins.

The rotary is entirely supported by the steel and concrete floor of the building, as shown in Figs. 1 and 3; the building being designed to carry such loads on the first floor. The basement space under the converter is, therefore, almost clear save for electrical apparatus. This electrical apparatus consists of a 250-kw regulator on the alternating-current end and two single-pole, 11,000-ampere, solenoid-operated circuit-breaking switches in the direct-current leads. The direct-current leads go directly to the bus-bars, the solenoid control circuit only being taken to the converter control panel. An excellent idea of a typical arrangement of circuits and apparatus in this sub-station is given by Fig. 1. The 9000-volt, three-phase lines enter through conduit

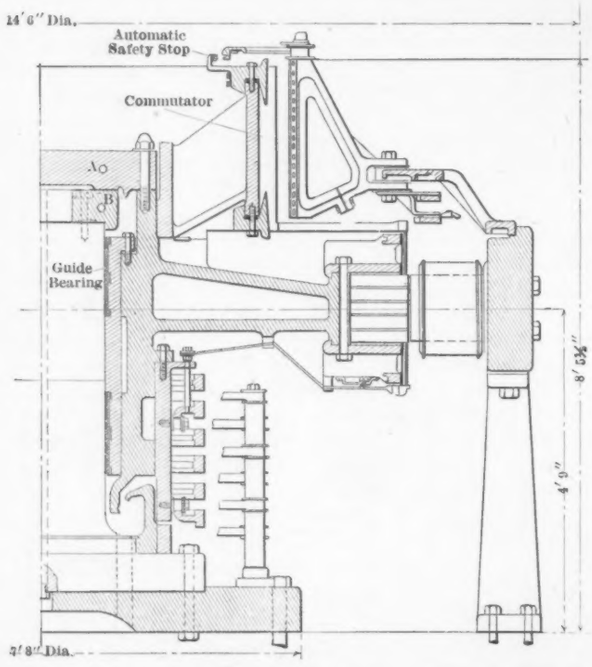


FIG. 2.—VERTICAL SECTION OF ONE-HALF OF 2000-KW VERTICAL-SHAFT ROTARY.

from the left, pass along the basement floor and thence up to the high-tension bus compartments and switchboard at the right. The 300-ampere oil switch shown at the upper right-hand corner of Fig. 1 controls the alternating-current end of the rotary converter, this being the only switch in the chain of apparatus until the direct-current leads of the converter are reached. In other words, the regulator and rotary converter are considered as a unit and are conductively connected together. From the high-tension switch, the leads pass under the floor to the transformer, which is on the main floor of the sub-station, close to the rotary converter. The low-tension, six-phase leads of the transformer pass through the floor to the regulator in the basement and then up to the collecting rings of the converter, which are just below the armature. From the converter, the direct-current leads go by the shortest possible route to the direct-current bus-bars and the energy passes out thence over the direct-current feeders, so that a minimum amount of copper is required for leads and switch connections. The high-tension bus-bar compartments in the new part of the sub-station are built of concrete slabs made to order and assembled on the job.

This rotary converter gives direct current at from 240 to 300 volts. The neutral of the low-tension side of the transformer is connected to ground and to the neutral of the direct-current system, thus doing away with the necessity of direct-current balancing sets. This is the standard practice of the Commonwealth Edison Company. The rotary converter is the latest addition to a sub-station which already has four 1000-kw horizontal shaft rotary converters. An interesting economic fea-

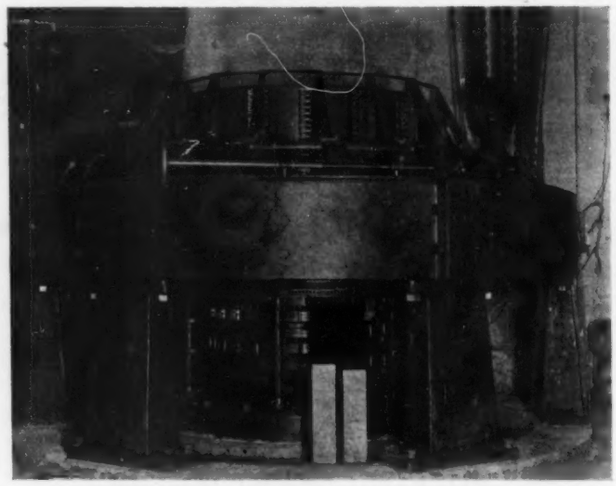


FIG. 3.—2000-KW VERTICAL-SHAFT ROTARY CONVERTER.

ture in this sub-station is the use of a transformer giving an increased voltage for one of the rotary converters in order that the direct-current voltage delivered may be high enough to charge the storage batteries there installed. The transformer connections allow the converter to be operated at an alternating e. m. f. of from 300 to 360 volts, instead of 240 to 300 volts. This gives a direct-current voltage sufficient to take care of battery charging and abnormal operation in case the voltage on some feeder needs boosting. It is considered cheaper and more satisfactory to purchase a transformer of this kind with extra

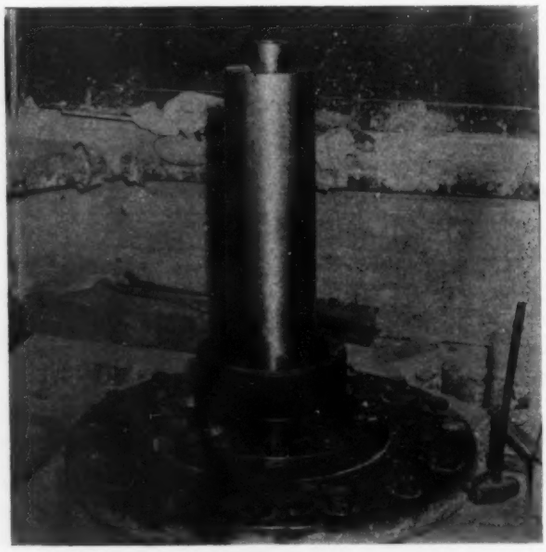


FIG. 4.—STATIONARY VERTICAL SHAFT OF A 1000-KW ROTARY CONVERTER.

voltage connections than to buy and provide room for a booster for battery charging.

The company has also contracted for a 1000-kw vertical-shaft, rotary converter for its Randolph Street sub-station under the Masonic Temple. Fig. 4 shows the shaft of this machine erected under the sidewalk where it is to be located.

LETTERS TO THE EDITORS.

The Beginnings of the Rubber Industry.

To the Editors of Electrical World:

SIRS:—In your issue of Nov. 23 the statement is made in a very interesting article on rubber by the well known authority, Mr. F. J. Hall, that the price of this material is fixed by the demand. It may be of passing interest to your readers to quote from a book printed about a century ago and long out of print. "The substance called Indian Rubber or Caoutchouc was not known in Europe until the beginning of the eighteenth century, having been brought from South America as a great curiosity. It appeared in the shape of bottles, birds, or other fantastically molded forms. Nothing could be learned of its origin until a body of French Academicians undertook a voyage to South America in 1735 when it was ascertained through traveling through Brazil that it was an exudation from a tree called the heve." The narrative proceeds to tell how it is cured and molded into various forms. "The usual method of drying is to spread a thin coating of the milky juice upon molds - - - These are then dried by exposure to the heat of a smoke-fire. - - - layer after layer may be put on until the desired thickness is achieved. - - - It will then be found to retain any impression that may be given to it." Anent the price that obtains to-day, and by the ruling of "supply and demand," it may be of interest to note the then demand. "More than 52,000 lbs. of caoutchouc were imported into England last year, being nearly double the quantity brought during the preceding year. Its price is 1s. 6d. per pound." As the employment of rubber had not then reached the usefulness in the manufactures that obtains to-day is attested by the writer's note: "For many years its only use has been to rub out lead pencil marks and it has become an important industry." As a prophecy the historiographer proceeds to say: "A thin coating of the solution spread on any texture renders it impervious to air or moisture; while, at the same time, it can be folded in as portable form as before it received the preparation - - - The use of rubber applied to a fabric will permit of making pillows, and even beds out of bags and thus be air-tight and these being made with an air cock may be inflated at pleasure into elastic cushions."

NEW YORK. H. F. FRASSE.

The Patent Office Gazette.

To the Editors of Electrical World:

SIRS:—The writer wishes to bring to the attention of your readers a recent action of the patent office in abridging the record of patent claims as published in the *Official Gazette*. Since Nov. 19 patents containing more than six claims have been cut down and only the first six claims thereof published. This is a matter of considerable importance to inventors and manufacturers in general, and should receive prompt and effective condemnation. Up to the present time the writer has seen no comment in the technical press on this subject.

The *Patent Office Gazette* is the only official general publication of the patents issued by the department, the claims of which are in a sense a part of the federal law, and as such should no more be abridged and thereby concealed from the general public than the laws and proceedings of Congress as published in the *Congressional Record*. The present action practically reduces the value of the *Gazette* to that of a mere index, for six claims of a patent often disclose no more than a small and possibly insignificant part of the subject matter of the invention, while the single illustration published has always been inadequate. Moreover, it will no doubt be found that attorneys will take advantage of the new rule and arrange the claims in such order that the first six when published will disclose practically nothing of the invention, if not actually misleading the reader as to the scope thereof.

There are a large number of inventors and others who subscribe for or have access to the *Gazette* and who follow up the record of patents in which they are interested. Heretofore in the majority of cases all of the information desired could be obtained directly from the *Gazette*, but under the new arrangement one who wishes to keep in fairly close touch with invention along a given line, or along several different lines, will have to procure complete copies of all patents issued along such lines, many of which on examination will then prove to be of little service except to cause him an unreasonable and unnecessary expense.

Such ill advised "economy" on the part of the Patent Office (if the slight saving in printing is responsible for this action) should meet with most emphatic protest in the press and at the department.

SYRACUSE, N. Y. H. C. FORD.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Turbo-Generators.—R. POHL.—A paper read before the (British) Institution of Electrical Engineers. The author discusses the limitations of direct-current machines driven by steam turbines. The mechanical or speed limit of the armature is defined by the circumferential velocity for which the tensile stresses reach their permissible limit. It is invariably the stress in the end shells protecting the connections which first approaches the limiting values. With ordinary bronze castings the maximum permissible speed will be about 50 meters per second, while with special phosphor-bronze and manganese-bronze castings it will be 75 meters per second. There is also a "flash-over limit," the most important factor being the potential difference between two adjacent commutator bars. As a safe limit in the case of turbo-generators 40 volts may be taken. This limits the number of lines of force allowed to enter or leave an armature of given diameter. There is also a limitation to the "specific load" (ampere conductors per centimeter of armature circumference). The author finds that up to a rating of about 500 kilowatts a direct-current dynamo can be built to the requirements of the steam turbine while for ratings above 500 kilowatts it is not possible to construct direct-current generators running at so high a speed as the equivalent turbine demands. This limitation may be overcome by artificially reducing the speed of the steam turbine, or by arranging two generators in tandem coupled to one turbine, the rating of each being one-half of the turbine output. Each method involves increased cost, and can only be considered as a temporary measure. It has been said that homopolar machines might be suitable for the high speeds of steam turbines, but the author shows that they are impracticable owing to the excessive amount of active material required. Further progress in direct-current turbo dynamos must be made by extending the sparking and the flash-over limit. This can be accomplished by working with a higher circumferential velocity of the armature, by employing certain steel alloys of very low magnetic permeability and high tensile strength. A further possibility seems to lie in adjusting the commutating field so as to extend the specific load line without exceeding the sparking limit. The reactance voltage increases in proportion to the armature current, therefore the characteristic of the commutating field should be a straight line; unfortunately, however, such is not the case, the curve being convex. The author has found that the following method allows an adjustment of the form of the characteristic. Use is made of a shunt to the commutating pole winding, the resistance of which increases rapidly with increasing load.

Iron resistors of the kind used for Nernst lamps are particularly suitable, although thin copper wires may also be employed, for which, without enclosing them in air-tight bulbs, high temperatures may be permitted. As will easily be seen, the ampere-turns on the commutating poles as a function of the load will now rise according to a concave curve, thus compensating for the curvature of the characteristic. Experiments have shown that an almost exact straight-line relationship between the intensity of the commutating field and the load is thus obtainable within very wide limits. Finally, there is a possibility of further extending the flash-over limit by using a special armature winding. Such a winding is described, though it has not yet been tested experimentally.—Lond. *Electrician,* Nov. 29.. In the discussion which followed the reading of the paper, Mr. G. G. Stoney stated that he considered the author's output limits rather low, and Mr. E. J. Fox made a few remarks from the turbine builder's point of view. Mr. Miles Walker considered a number of points of importance to users of the machines in question, and described a form of winding used by the British Westinghouse Company to diminish the voltage between segments. Prof. Silvanus Thomson discussed the flash-over limit, and showed a drawing of a homopolar machine designed some 15 years ago. Mr. A. C. Eborall gave a few particulars of a Continental design of machine, and Prof. G. Knapp mentioned a number of points especially as regards the speed of response of the commutating pole to sudden variations of load. Mr. S. Evershed related experiences with an early machine, and Mr. A. G. Ellis showed some curves of maximum speeds and outputs.—Lond. *Elec. Eng'ing,* Dec. 5.

Design of Turbo-Generators.—H. M. Hobart.—A fully illustrated article on last year's progress in the design of electric generators for direct connection to steam turbines. During the last 12 months notable progress has been made in the manufacture of turbo alternators of very large rating, the largest being 9000 kilowatts. Some notes and illustrations are given on details of ventilating devices and means for securing the end-connections of alternator stator windings. Direct-current turbo-driven generators are satisfactory only in much smaller sizes, and some details are given of improvements in commutator construction, brushes, brush holders, special windings and field construction. Interpoles and compensating windings cannot be said to constitute necessary attributes of direct-current turbo-generators. Recent inventions in armature windings are of considerable promise and may lead to such good results as to enable interpoles and compensating windings to be dispensed with in some cases.—Lond. *Electrical Eng'ing,* Dec. 5.

Parallel Connection of Three-Phase Transformers.—G. Stern.—A translation with illustrations of his recent German paper on this subject.—Lond. *Electrician,* Nov. 29; Lond. *Elec. Review,* Nov. 15.

Lamps and Lighting.

Photometry of Colored Light.—F. L. Tufts.—In the case of colored light the definition of luminosity may be based on the rule that two similar surfaces illuminated respectively by two lights of different color are said to be of the same luminosity if, on rapidly replacing one by the other before the eye there is no sensation of flickering. This is the principle of the flicker photometer. In the present paper the author describes a new form of spectrophotometer for the measurement of color luminosities according to this definition and gives the results of measurements of the luminosities of the different parts of the spectrum as they appear to normal and to color-blind eyes. The chief results are as follows. The retina of the human eye contains two distinct sense organs—one, the luminosity sense, the other, the color sense. The luminosity sense is affected qualitatively in the same way by light stimuli of all wave-lengths within the visible spectrum, so that it reacts, after fatigue, always in the same way, no matter what kind of light is used to fatigue the retina. (The only exception to this is when the fatigue is caused by prolonged exposure to the long, or red, rays of the spectrum.) The relation between the wave-length and luminosity in the case of a 50-cp incandescent lamp may be represented by a wave-length luminosity curve which, for most eyes, is identical with the curve in Fig. 1. Deviations from this normal curve fall, for the most part, into one or the other of two classes: (1) The point of maximum luminosity may be displaced towards the red. (2) It may be displaced towards the green. Persons possessing perfectly normal color

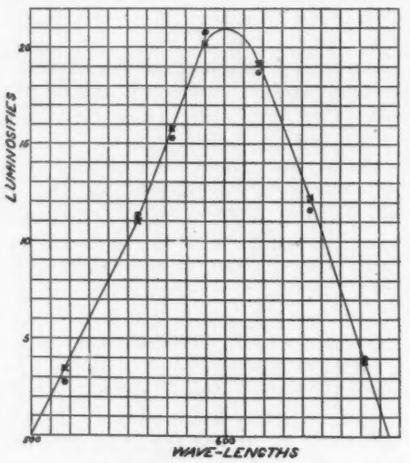


FIG. 1.—WAVE-LENGTH LUMINOSITY CURVE.

vision may have an abnormal wave-length luminosity curve, and color-blind persons as often have a wave-length luminosity curve belonging to class 1 as to class 2.—*Physical Review,* December.

Traction.

Car with Side Rods.—An illustrated description of recent tests made by J. Murphy in Pittsburg with a car equipped with two motors and side rods connecting the axles of each truck. Tables showing the saving effected by this car are given.—*St. R'y Jour.,* Dec. 14.

Overhead Construction.—An illustrated description of the overhead construction on a 15-cycle, single-phase railway in California. Bracket construction is used for both single and double tracks. Span construction is used only with three or four tracks.—*St. R'y Jour.,* Dec. 7.

Single-Phase Traction.—A. Heyland.—A translation of his German paper on the use of combinations of single-phase induction motors with slip-ring rotors, but without commutators, for traction purposes. The German paper has already been abstracted in the Digest.—Lond. *Electrician,* Nov. 22.

Railway Signals.—W. E. Foster.—The conclusion of the illustrated serial on railway signaling. In the present instalment the language of fixed signals is dealt with.—*Electric Journal,* December.

Installations, Systems and Appliances.

Obtaining Constant Current with Varying Potential Difference.—O. Sackur.—An illustrated description of an automatic regulator for obtaining constant current of varying potential difference. The current passes through a cell, decomposing water, the oxy-hydrogen gas generated escaping through a fine capillary. Within the electrolytic cell there is thereby created a pressure which is proportional to the current. This pressure is indicated on a manometer tube, and by means of connections of the manometer tube to a series of resistors, etc., the difference of level of the mercury in the manometer tube is maintained constant so that the current also remains constant. Tests show that this system works satisfactorily and that the current remains constant within two per cent, even when the working pressure varies more than 10 per cent.—Lond. *Electrician,* Nov. 15.

Switchboards.—B. P. Rowe.—The conclusion of his illustrated serial on electrically-operated switchboards. Notes are given on elevated panel instrument switchboards, wattmeter, watt-hour meter and relay panels, edgewise-type feeder switchboards,

field rheostats and field switchboards, direct-current exciter switchboards, station apparatus, auxiliary direct-current circuits, controlling and instrument switchboards, generator control pedestals, and calibrating jacks.—*Electric Journal,* December.

Mainz.—FURKEL.—The first part of an illustrated description of the municipal electric station of Mainz, the equipment of which is rated at present at 4000 horse-power. During the next year a 3600-hp steam turbine is to be installed. Three-phase currents are generated at 2300 volts, the frequency being 51.5.—*Elek. Zeit.,* Dec. 5.

Electrophysics and Magnetism.

Gradual Modification of the First Linear Spectrum of Emission of Mercury.—E. CASTELLI.—With reference to Sir William Ramsay's discovery of the transformation of several elementary substances, the author describes an observation made by him in taking some spectra photographs of the electric arc in mercury vapor contained in a uviol lamp. He observed a considerable difference between the spectra when the uviol lamp was almost new and later after it had been working during short periods separated by long intervals for about 100 hours. He found that the group of three lines, of the wave-lengths 3663.3, 3654.9 and 3650.3 Angström units, had nearly completely vanished; while the three lines 5790.49, 5769.45 and 5460.97 which in the first experiment had given a scarcely visible photographic impression, now produced a much clearer and a more intense impression than any other line. "As it is now generally believed that the vibration corresponding to each line of the spectrum of an element must be considered as due to its positive ions, I think the modification I have noticed in what Prof. Stark calls the first linear spectrum of mercury, must be considered as depending on an alteration in the character of the positive monovalent ions, probably consisting in such a variation of the vibrating mass that it renders oscillations of a higher frequency impossible, while the vibrations of less wave-length, due to a state of a smaller ability for motion, are made easier and, therefore, intensified."—*Phil. Mag.,* December.

Gas Given Off from Aluminum Electrodes.—R. VON HIRSCH AND F. SODDY.—When cathode rays are generated by means of an influence machine in pure gases, the relation between the gas pressure p and the discharge potential V can be represented by $p^2V =$ constant. This relation holds for pure gases independently of the amount of current in the tube, but does not hold at all for gaseous mixtures. During the passage of the discharge a gas is continuously evolved from the electrodes if they are of aluminum, which renders the gas initially filling the tube impure so that the above relations cease to hold. If, however, the discharge is passed for some hours, the gas being pumped out as evolved, so as to maintain the pressure within the range required for the production of cathode rays without unduly increasing the resistance of the tube, the value p^2V becomes a constant independent of the nature of the gas initially filling the tube, and is about one-fourth of the value of hydrogen. The authors endeavored to identify this gas, but have not yet succeeded. From its electrical behavior, it seems that it must be a pure gas, probably with a molecular weight of 4 or some multiple. The phenomenon is connected with the presence of some impurity in the aluminum.—*Phil. Mag.,* December.

Radium.—E. RUTHERFORD.—A paper on the production and origin of radium. Over the time of observation, 305 days, radium was produced in actinium preparations at a constant rate. By suitable chemical treatment it is possible to obtain actinium preparations which produce radium extremely slowly. The active deposit of actinium does not change directly into radium. The results of the author indicate that in the ordinary actinium preparation there exists a new substance which is slowly transformed into radium. This direct parent of radium can be chemically separated both from actinium and radium. Observations have not extended over sufficient time to settle whether this parent of radium has any direct generic connection with actinium or not.—*Phil. Mag.,* December.

Selenium Cell.—Two papers by F. C. Brown and J. Stebbins deal, respectively, with the variation of the light sensitiveness of the selenium cell with pressure and with the effect of radium on the resistance of a selenium cell. A paper by E. Merritt gives the results of an investigation of the recovery of selenium cells after exposure to light, as influenced by the duration and intensity of the previous excitation. The author finds a remarkable resemblance between the behavior of selenium, as indicated by the change in its conductivity, and the behavior of a phosphorescent substance, as indicated by the intensity of its phosphoresence.—*Physical Review,* December.

Resistance.—H. K. ONNES AND J. CLAY.—An account of an experimental investigation of the change in the resistance of metals at very low temperatures and the influence exerted on it by small amounts of admixtures.—Lond. *Electrician,* Nov. 29.

Fused Salts.—H. M. GOODWIN AND R. D. MAILEY.—The first part of an account of an experimental investigation of the density, electric conductivity and viscosity of fused salts and their mixtures.—*Physical Review,* December.

Units, Measurements and Instruments.

Transportable Standard Cell.—R. E. DELURY.—A description of a transportable form of standard cell, the contents of which cannot mix even though the cell may be inverted or shaken. In a piece of tubing A (the first diagram of Fig. 2) of suitable thickness, 15 cm or 20 cm long and 1.5 cm to 2.5 cm in diameter, there is placed another piece B, 6 cm to 8 cm long and 0.5 cm to 1.0 cm in diameter. In the ends of A there is inserted a tight-fitting cork C through which pass the small tubes D, one of which is open, the other sealed. The lengths of the tubes D are so adjusted that they enter B just enough to

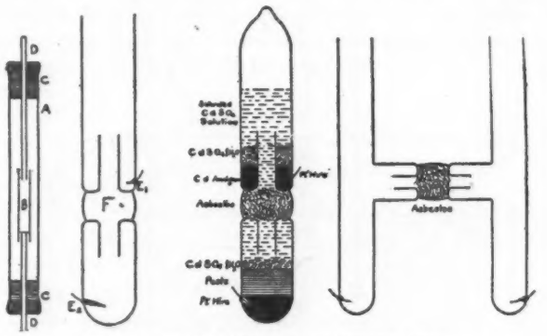


FIG. 2.—TRANSPORTABLE STANDARD CELL.

hold it co-axial with A. The whole is held horizontally and is rotated in the small pointed flame of a blowpipe—or, better, in the flames of two blowpipes pointing into one another. The tube A is melted in a narrow band nearly opposite the middle of B. At this point A adheres to B, and after the tubes are thoroughly fused together they are blown out. While the tube is still warm, the platinum wire E_1 is fused in above the bulb of the cell, in the usual manner. The corks are now withdrawn and one end of the cell is sealed and another platinum wire E_2 fused into it. The cell, which now appears as shown in the second diagram, is filled as follows: Mercury is put in the bottom of the tube by means of a small pipette or funnel made by drawing out a test-tube. Above this is placed the mercurous sulphate paste and cadmium sulphate crystals by means of a small tube. Then by means of a pipette sufficient cadmium sulphate solution is put into the cell to fill the bulb F. Air will thus be entrapped below F, and to remove it suction is applied at the end of the cell. On removing the suction, the solution will rush down to fill the space below the bulb. Some asbestos or glass-wool is now pressed down through the inside tube to fill the bulb F, packing it in fairly tightly, yet not so compactly as to make the internal resistance of the cell too great. Enough cadmium amalgam is then put in the space above F to cover the platinum wire E_1 completely. Above this is placed cadmium sulphate crystals and enough saturated cadmium sulphate solution is added to fill the cell about a centimeter above the end of the inside tube. Several centimeters above this point the tube is sealed or a cork is inserted, and the

cell is completed as represented in the third diagram. The H-form of cell is made transportable by employing a similar "double-trap" in the cross-tube connecting the two legs, as shown in the fourth diagram. In this case the asbestos is put into the bulb before the cross-tube is sealed to the legs.—*Physical Review,* December.

Standard Cells.—F. A. Wolff and C. E. Waters.—A long paper on the Clark and Weston standard cells, with detailed description of their construction and of the preparation and purification of the materials, and the results obtained at the Bureau of Standards, in Washington. It is found that standard cells can be set up by different investigators with different materials, which agree to within a few parts in 100,000. Standard cells can also be constructed which show no appreciable change when carried considerable distances, even on ship board, provided ordinary precautions are observed. In a second paper, the same authors discuss the electrode equilibrium of standard cells. —*Bull. Bureau of Standards,* Vol. 4, No. 1, December.

Effect of Humidity on Manganine Resistances.—E. B. Rosa and H. D. Babcock.—Their full paper on the variation of manganine resistances with atmospheric humidity, a preliminary account of which appeared in the Electrical World for June 29, 1907.—*Bulletin, Bureau of Standards,* Vol. 4, No. 1, December.

Barretters.—An article on the use of barretters or bolometers made by an English firm for measuring small alternating or fluctuating currents. It consists essentially of a conducting wire or filament which has a high temperature-resistance coefficient and a small mass, so that small currents will appreciably raise its temperature, and thus alter its resistance. In the present instrument a fine carbon lamp filament is employed, with which the greatest variations of resistance occur with small currents. Fig. 3 shows the arrangement of the circuit for zero method.

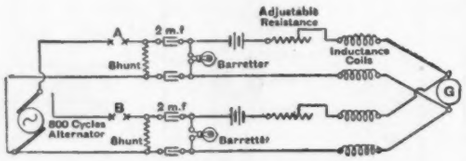


FIG. 3.—DIAGRAM OF CIRCUIT.

A source of alternating current, such as a sine-wave alternator, is connected to two branch circuits, in one of which a rheostat is inserted at *A*. The other arm has the apparatus on line to be measured inserted at *B*. The barretters are connected through rheostats and batteries to the galvanometer.—Lond. *Electrician,* Nov. 22.

Effect of Frequency on Resistance and Inductance.—L. Cohen. —The resistance and inductance of a conductor depend on the distribution of the current within the conductor. In the case of a fluctuating or alternating current eddy currents with their accompanying magnetic fields will be generated within the conductor, which will alter the distribution of the current and consequently change the resistance and inductance of the conductor. For a straight, cylindrical wire the problem has been satisfactorily worked out, but the results obtained for a straight wire will not hold when the same wire is wound into a coil. The change in resistance of a coil for any given frequency is much larger than if the windings of a coil were drawn out into a straight conductor. The author has studied this subject again theoretically and experimentally and his experiments are in agreement with his theoretical results. (See Electrical World, Sept. 21, 1907, p. 564.) He concludes that the change in resistance of a coil is a function of the frequency, the section of the winding and the pitch of the winding.—*Bull., Bureau of Standards,* Vol. 4, No. 1, December.

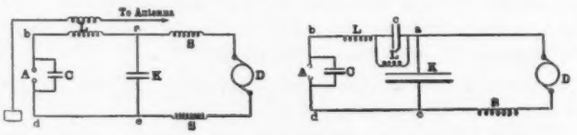
Self-Inductance of Rectangular Coil.—E. B. Rosa.—One of the most carefully constructed standards of self-inductance is that of Froehlich, who uses a large marble ring of rectangular section, wound with a single layer of fine silk-covered wire. Each turn of the wire lies in a plane passing through the axis of the ring, the wires being wound as closely as possible on the inner surface of the ring and uniformly spaced on the outer surface. The present author discusses the formula for the self-inductance of this coil, and by means of several numerical examples he emphasizes the serious error which may result from assuming the winding of fine wires to be equivalent to a current sheet; for a given spacing of the wires, the finer they are, beyond a certain point, the greater is the error arising from this assumption. The straight solenoid offers many advantages over the circular solenoid as a standard. It is easier to construct and measure the core, and immensely easier to wind, and the calculation of the self-induction from the dimensions is just as easy and just as certain.—*Bull., Bureau of Standards,* Vol. 4, No. 1, December.

Self-Inductance of Circles.—E. B. Rosa and L. Cohen.—A critical discussion of the convenience and reliability of the various formulas which have been proposed by different authors for the self-inductance of closed rings of circular cross-section. —*Bull. Bureau of Standards,* Vol. 4, No. 1, December.

Mutual Inductance.—A. Campbell.—An illustrated Royal Society paper on a standard of mutual inductances, whose value can be determined solely from geometrical dimensions. The design worked out by the author consists essentially of two coaxial helixes of equal and finite length, with a secondary coil midway between them.—Lond. *Electrician,* Nov. 22.

Telegraphy, Telephony and Signals.

High-Frequency Oscillations.—A. Blondel.—The well-known disposition of Duddell's singing arc for producing high-frequency oscillations is not applicable in high-tension continuous-current circuits, partly because of the short-circuiting of the dynamo by the arc, and partly because the necessary presence of self-inductance circuit hinders the rapid charge and discharge of the condenser. To avoid these defects, the author proposes the circuits shown in Figs. 4 and 5. Both are characterized by the fact that a condenser of very great capacity is associated with the much smaller condenser across the spark-gap. The large condenser *K* is charged directly from the dynamo *D* through one or two impedances *S*, on one or the other of the leads. These impedances might, however, serve without self-inductance; that is, might be mere resistances. In the first arrangement the large condenser *K*, which has a capacity at least five times as great as that of the oscillatory condenser *C*, receives a charging current limited by the presence of the impedances *S*. The spark-gap, which is shunted by the condenser *C*, produces the discharge of this condenser as soon as the sparking potential is reached. Then the condenser *C* recharges itself through the self-induction of *L* (there may be one on each spark-gap lead, or only one on one of the leads). The rapidity of this charging depends on the proper period of oscillation of the circuit *abCdeKa*, and is partly determined by the e. m. f. disposable at the terminals of the condenser *K*. On the other hand, the impedances *S* prevent the oscillations of the oscillating circuit from making themselves felt in the dynamo. The presence of the condenser *K* contributes to this result because the natural period of the circuit *DaKeD* is longer the greater the capacity of *K*. By using large inductance in *S* this period may be made as long as we please, and by adding to the resistance such oscillations are easily damped out. In the second arrangement illustrated, the formation of an arc is completely avoided because there is no direct communication between the dynamo and the spark-gap. The circuit *abCdeKa* is in effect cut by one or more condensers *c*. The self-inductance *L* may be all on one lead or may be divided. The arrangement may easily be so modified as to become symmetrical. These arrangements are self-regulating.—Lond. *Electrician,* Nov. 22.



FIGS. 4 AND 5.—HIGH-FREQUENCY OSCILLATIONS.

Wireless Telegraphy.—K. E. F. SCHMIDT.—An account of an investigation of the effectiveness of the hydrogen spark-gap in wireless telegraphy. The author has determined the resonance curves obtained at a receiving station when the sparks at the sending station are produced in air and in hydrogen. Previously published laboratory experiments by the same author had shown decidedly that whereas with sparks in air it was very difficult to produce in successive attempts oscillations of constant intensity, under what were apparently identical experimental conditions, yet, with the sparks in hydrogen, the measurements made on different occasions were very concordant. In consequence of these benefits, the author has compared under conditions approaching those of actual telegraphy the resonance curves of his apparatus, when air and hydrogen spark-gaps were employed. Resonance curves are given for the sending circuits, and show, contrary to expectations, that the damping in both closed and open circuits with spark-gaps of 5 mm. and of 10 mm. is much greater in hydrogen than in air at atmospheric pressure. The logarithmic decrements in the closed circuit were 0.5 for hydrogen and 0.3 for air, and in the open radiating circuit 0.9 and 0.3. The radiating circuit was a "harp" of 10 wires 20 metres in length, held vertically, and 1 metre apart, plus a similar horizontal harp 5 metres from the ground. Measurements at a receiving station 350 metres distant show, in addition, that hydrogen yields effects considerably feebler than does air, as well as appreciably higher damping.—Lond. *Electrician,* Nov. 22.

Transmission of Pictures.—An article on the Belin system of electric transmission of photographs. It differs from the Korn system since no selenium is employed. The picture to be sent takes the form of a relief, over which a pointer passes, which controls a small rheostat. In the receiving apparatus an oscillograph causes a beam of light to move over a screen of graduated density, by which it is more or less intercepted.—Lond. *Elec. Eng'ing,* Nov. 28.

Telegraph Line Construction.—HARTUNG.—An illustrated article on the erection of telegraph lines in the German colonies in Africa, with special reference to the difficulties due to the lack of railways.—*Elek. Zeit.,* Nov. 14.

Miscelianeous.

Technical Training.—G. KAPP.—His presidential address to the Birmingham local section of the (British) Institution of Electrical Engineers dealt with the question of technical training of electrical engineers, and advocated the more general introduction of what is sometimes known as the "sandwich" system, in place of the premium-pupil system. In the "sandwich" system the student is allowed to work in shops without premium during the vacation. Most of the speakers who discussed the paper thought that the best system in any case depends upon the individual student and believed that workshop experience extending only the length of the vacations is too short. One speaker recommended alternating a year's practical work with a year's theory; another advocated a year's college training, followed by three years in the shops (during which time two afternoons a week should be allowed for attendance at classes), then a winter session at college, a summer in the shops and a final winter course of college work.—Lond. *Electrical Eng'ing,* Nov. 21, 28.

Argentine.—GLIER.—A statistical article. The number of inhabitants of the Argentine Republic has increased from 4,625,000 in 1901 to 5,360,000 in 1906; the yearly import of electrical apparatus and machines has increased in the same time from $635,000 to $3,430,000. While in 1901 30 per cent of the total imports into the Argentine Republic came from the United States, only 9 per cent of the total imports came from this country in 1905. On the other hand, while Germany participated in imports to Argentine to the amount of 60 per cent in 1901, this figure increased to 54 per cent in 1903 and 56 per cent in 1904 and 1905. The chief objects of import are wire, incandescent lamps, dynamos, arc lamps, and measuring instruments.—*Elek. Zeit.,* Nov. 28.

BOOK REVIEWS.

THE CLASSIFICATION OF ALTERNATE-CURRENT MOTORS. By V. A. Fynn, M. I. E. E. London: "The Electrician" Printing & Publishing Company. 41 pages. 46 illustrations. Price, 3 s.

The difficulties to be surmounted in producing a consistent classification of alternating-current motors will be appreciated when one considers the large number of forms that have been proposed since the beginning of the development of single-phase commutator motors. If one allowed his opinions to be formed from present day electrical literature, he would consider that there are three general types of alternating-current motors, the synchronous, the induction and the commutator. In his classification, the author ignores the synchronous motor entirely, he represents the induction motor diagrammatically as possessing a commutator and he omits the word "commutator" when designating the various forms of alternating-current commutator machines. In spite of these seeming absurdities, Mr. Fynn has succeeded in obtaining a logically arranged and consistent designation of alternating-current commutator and induction motors.

According to the terms selected by the author, a "series motor" is one in which the field excitation varies in some proportion with the armature current and the speed of which varies with varying load; a "shunt motor" is one in which the working e. m. f. and the field excitation remain practically constant at all loads; a "conduction motor" is one in which the energy required for its operation is conveyed to the rotor by conduction, while in an "induction motor," the energy is conveyed by induction; a "self-excited motor" is one in which the exciting current comes from the rotor, while a "separately-excited motor" obtains its exciting current from the supply mains.

According to the above terms the well-known "conductively-compensated series motor" becomes a "neutralized, single-phase, series, conduction motor;" our old friend the "single-phase induction motor" becomes a "self-excited, partly-compensated, single-phase, shunt, induction motor," and the so-called "plain repulsion motor" is a "single-phase, series, induction motor." A Wagner induction motor would probably be designated as a "self-excited, partly-compensated, single-phase, shunt, induction motor started as a single-phase, series, induction motor." Although many of the names suggested by the author are entirely too long and awkward for general use, his method of classification deserves the serious consideration of all writers on alternating-current motors. The author deserves especial credit for his effort to abolish the term "repulsion motor," which has hitherto been applied to a type of commutator motor, with brushes short-circuited along one axis, in the operation of which there is absolutely no repulsive thrust, although the name commonly applied might lead one to believe that such a thrust does exist.

LINCOLN IN THE TELEGRAPH OFFICE. By David Homer Bates. New York: The Century Company. 431 pages; 800 illustrations. Price, $2.

As manager of the War Department telegraph office at Washington and cipher operator during the Civil War, Mr. Bates enjoyed peculiar and unrivaled opportunities to secure the material upon which this fascinating book is based. He and his associates, General Eckert and Messrs. Chandler and Tinker, were a quartette highly representative of the superior ability and character that the telegraph enlisted when it offered more of a career to talent than it does to-day. Their work under Staton, the great War Secretary, is set forth admirably in these pages, and a most interesting revelation is made of Lincoln from a new and fresh point of view, with a wealth of incidental fact and story.

There is much in this direct and incisive narrative, told in plain, nervous English, that is of technical interest, but, fortunately, Mr. Bates does not dwell on that aspect of the first great use of telegraphy in actual warfare. He gives, however, with good judgment, some very full data as to codes and cipher

dispatches, including actual cipher codes, telegrams and letters, all deserving of study. The art of military telegraphy has been built up since that time, and our own U. S. Signal Corps has done its brilliant share in a process that may be traced back to the days when a few hundred gallent young operators rallied to the service of both North and South, and, if called upon for the sacrifice, died gladly at their keys, upon the field of honor.

But it is with Lincoln that this human book deals, and after its perusal, one lays it down with a keener love and stronger admiration for that noble leader of men. All unconsciously, with a naivety that is for the author his best recommendation, Mr. Bates depicts Lincoln in the telegraph office in days of leisure and preparation, in moments of jest and jocularity, and in hours when suspense and anguish rocked as with earthquake throes the seat of government. Mr. Bates is both happy in his opportunity and felicitous in his poignant reminiscences of a time when the telegraph office at Washington and its wires and operators were the nerve centers of our Republic.

Neuere Elektrophysikalische Erscheinungen. By Ernst Ruhmer. Teil I. Fortschritte auf dem Gebiete der Telegraphie und Telephonie. Berlin: F. & M. Harrwitz. 213 pages; 215 illustrations. Price, 4 marks.

This section of the treatise on recent electrophysical applications, in its second edition, is devoted to the progress of telegraphy and of telephony. The principal subjects discussed are (1) the fast automatic telegraphs of Wheatstone, Delany, Pollak-Virag, Crehore and Squier, Murray and Siemens-Halske; (2) the various duplex telegraph systems; (3) telegraph cable apparatus, very briefly discussed; (4) long-distance printing telegraphs; (5) telautographs; (6) copying telegraphs. A full chapter is given to recent telephonic progress.

The book is descriptive and somewhat popular in form rather than technical. It is well illustrated, and will be useful to those interested in recent telegraphic or telephonic progress, whether technically trained or not. It is not particularly directed to the use of designers of such apparatus. Some of the descriptions are adequate and clear. Others are very brief and inadequate.

Polyphase Induction Motors.

In the type of induction motor illustrated herewith there have been introduced several new constructional features that

FIG. 1.—STATOR WITH WINDING IN PLACE.

contribute to an improved performance, but do not materially alter the appearance as compared with established practice of recent years.

An entirely new construction has been employed for the rotor. The ends of the bars are bevelled and the resistance ring, which is also bevelled, is clamped by bolts at both ends; this gives a very solid rotor of neat appearance. Partially closed slots are used in the rotor, and the winding consists of square bars, thoroughly insulated from the core.

In all except the very small sizes, the design is such that a current of air enters the motor at one end and passes out at the other, coming in contact with the outer surface of the stator core, and the inner surface of the rotor core. This gives a very effective ventilation.

The stator winding consists of form-wound coils laid into partially closed slots. The partially closed slot has been adopted as giving a machine with a better power factor than the open

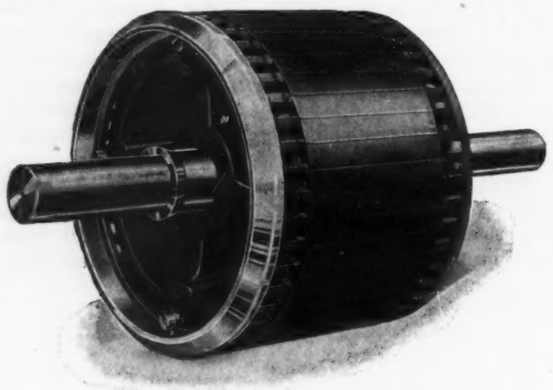


FIG. 2.—ROTOR OF INDUCTION MOTOR.

slot. Moreover, the air-gap is small, the large shaft running in bearings of special hard bronze composition permitting this construction. The whole arrangement is such as to utilize the active material to best advantage.

The performance characteristics of a 3-hp, three-phase, four-pole, 60-cycle, 220-volt motor are shown in Fig. 4. The high efficiency and power factor are seen at a glance. It is stated that the temperature rise does not exceed 40 deg. C. for continuous operation at full load, or 55 deg. C. at 25 per cent overload for three hours, and the motor will carry 150 per cent overload momentarily. The curves show the overload range in a striking manner.

No starting apparatus is needed for motors rated at less than five horse-power, because they may be connected directly to the supply lines. With motors rated at more than five horse-power use can be made of auto-transformers for lowering the voltage

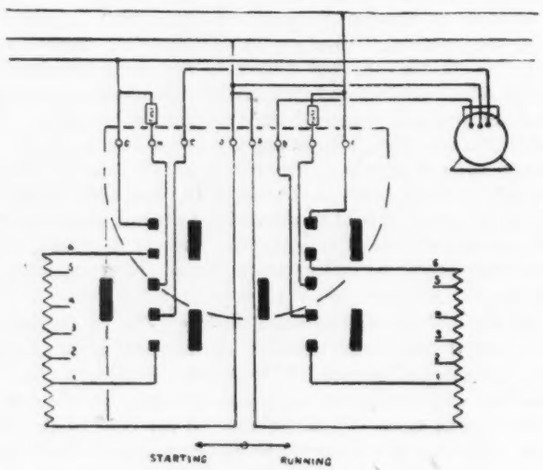


FIG. 3.—DIAGRAM OF CONNECTIONS FOR THREE-PHASE AUTO-TRANSFORMER.

during the starting period, or of resistance in the primary circuits for limiting the current while starting. The former type of starter is recommended wherever a large starting torque

is required, while the latter type is advantageous for motors of not over 20 horse-power that are to exert a small torque while starting.

The above described induction motors and starting devices

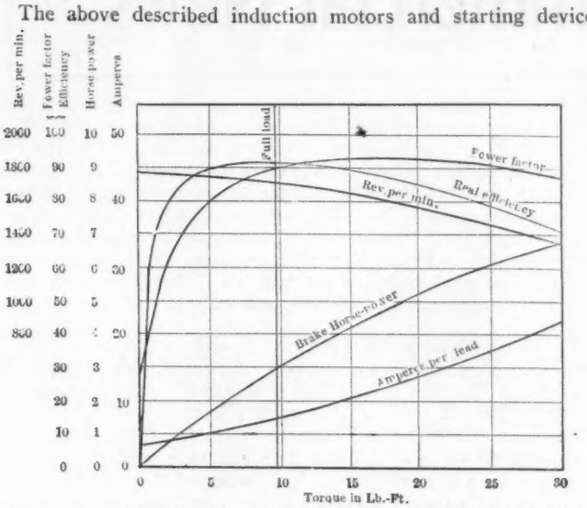
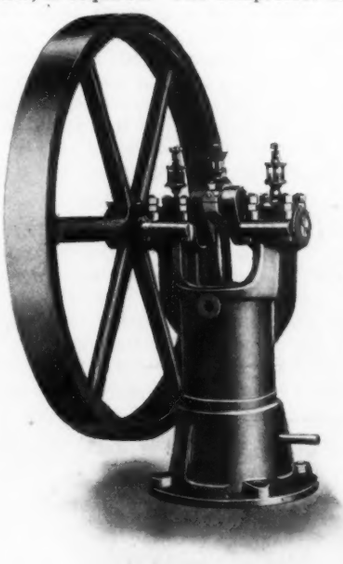


FIG. 4.—CHARACTERISTICS OF 3-HP, 220-VOLT, THREE-PHASE MOTOR.

have been developed by the Barriett Electric Manufacturing Company, Cincinnati, Ohio.

Belt-Driven Air Compressor.

The Westinghouse Air Brake Company has developed a small belt-driven compressor, which it is prepared to manufacture in large quantities. The compressor weighs 218 lbs., and its base is 12 ins. in diameter. Its compact build enables it to be located in limited space where power from shafting or small motor drive is available. It is particularly adapted to gas engine starting, automobile garage use, charging storage tanks for small pneumatic tools, general machinery cleaning and in a great variety of cases where compressed air at high or low pressure, but in small quantities, is required. The compressor is of the vertical



AIR-COMPRESSOR.

single-cylinder, single acting, water-jacketed type, operated by power delivered to a 30-in. flywheel, attached to a crank shaft, the rotation of which drives the piston in the cylinder by means of a connecting rod. The diameter of the air cylinder is 3 ins., the stroke of the piston is 4 ins. It is said to operate satisfactorily against any air pressure up to 250 lbs. At 250 r. p. m., its speed of maximum efficiency, and against 200 lbs. air pressure, approximately one brake horse-power is required to operate the pump.

Long Test of Automobile Spark Generator.

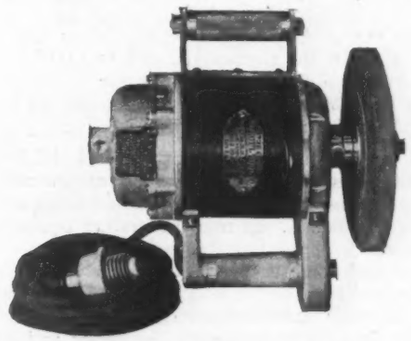
Visitors to the two automobile shows held in New York will recollect the interest aroused by the endurance test conducted by the Atwater Kent Mfg. Works as a demonstration of the high battery economy obtained with their spark generator for ignition. It will be recalled that in this test a spark generator was connected with six No. 6 Columbia dry cells, four spark plugs, and a Jones speedometer-odometer, the whole apparatus being sealed in a glass cabinet and run by an electric motor during the whole of both shows. At the beginning of the test the batteries tested an average of 16 amperes each, and at the end of the second show, with the odometer reading 4249.3 miles and the batteries testing over 6 amperes each, the plugs were still sparking.

As this test did not prove conclusively how much further the batteries might have run before the spark plugs began to miss, the Atwater Kent Mfg. Works transferred the entire outfit to the Chicago show, on the opening of which the batteries were again tested publicly, the cabinet resealed and the apparatus started running again. In the three weeks between the shows the battery had deteriorated somewhat, so that the cells tested only 4½ amperes average. The odometer was started at 4249.6 miles, and at 5328.6 miles the plugs began to miss. On publicly unsealing the cabinet, the batteries were found to test an average of three amperes. In other words, they had lost only 1½ amperes in over 1000 miles, which shows, more strongly than anything else could, the exceedingly small consumption of energy. The spark generator was in perfect condition, and on inserting fresh cells, regular sparks were obtained without readjustment. The makers state that it would easily have been possible to obtain sparks with cells testing as low as one ampere by readjusting the contact screw, but that for the purpose of the test the screw was adjusted to suit fresh batteries, and thereafter was not changed.

The apparatus was sealed at Chicago by F. E. Watts of the *Horseless Age*, and the sealing and testing of the cells was witnessed by C. A. Coey, S. Strasser of *Motor Age*, Chas. Miller and F. M. Ruwet. The cabinet was unsealed by S. Strasser in the presence of A. L. Haskell and James Vernon.

Portable Metal-Grinding Machine.

The accompanying illustration shows a portable metal-grinding machine that has been placed on the market by the Cincinnati Electric Tool Company, 630 Evans Street, Cincinnati, Ohio. The operating and controlling switch for the driving motor is located in the right-hand handle of the machine, so that the



PORTABLE METAL-GRINDING MACHINE.

operator need not release his hold for starting and stopping the motor. Air for cooling the equipment is furnished by a rotary fan mounted on the shaft.

The machine weighs 25 lbs. complete; the motor is wound for direct current at an e. m. f. of 110, 220 or 550 volts. It is arranged so that a buffing wheel can be substituted for the emery wheel. When arranged as a buffer, the machine is useful around garages, engine rooms, generating stations, etc., for polishing bright parts.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The holiday trade was of normal proportions, earlier losses being apparently recovered, and in staple lines conditions were better, due to the more seasonable weather. Although actual business did not increase in the leading industries, there was a more confident sentiment regarding the future, and numerous inquiries encouraging manufacturers to anticipate a steady improvement in orders early in 1908. Meanwhile, inventories are being taken and machinery thoroughly overhauled and repaired for the first time in many years. Statements made by representatives of various trades show that November business as a rule was very satisfactory. Business in general, they state, is sound and the outlook is very promising. In the steam-boiler trade, it is stated that there has been no let-up in orders and from the way that orders are being received, there is no reason to believe that business will not continue improving. In the business of railroad supplies a satisfactory condition exists. In some cases, however, it cannot be denied that business has fallen off somewhat in the past two months, but a speedy revival at the first of the year is looked for. The machinery trades do not seem to have suffered to any extent, many of the orders which had been delayed owing to financial troubles are now coming in, and there is every prospect of a steady increase in business in the near future. The tool and hardware trades suffered a falling-off during November, but these are now picking up. In the textile trades a similar hopeful view is expressed, and it is expected that the normal output will be resumed early in the year. Manufacturers of passenger cars state that they are clogged with orders which will keep them busy for the next three years; their factories have been running overtime for the past three months and yet they have not kept up with the demand. The official report of foreign commerce in November showed a trade balance of $93,655,751, which far surpasses any previous monthly record of exports. Conditions in financial circles are still very slow in approaching normal and as yet reflect little benefit from the current holiday purchasing. There was an increased inquiry for pig iron in some markets, but actual business still continues very quiet, and prices in general are much lower. The feature of the entire situation is a general suspension of furnaces and mills, and in finished lines it is figured that new business hardly covers 33 per cent of the total capacity. The demand for structural material was moderately good. Copper was weak and prices were again being forced below 13 cents. It is estimated that surplus stocks are very heavy and that production may have to be restricted to a greater extent before actual permanent betterment can be expected. The closing quotations were 13 3/16c. for Lake, 13 1/16c. for electrolytic, and 12 13/16c. for casting stock. Business failures during the week ending Dec. 19 as reported by *Bradstreet's* numbered 300, against 234 in the week previous and 227 in the corresponding week last year.

ADDED EQUIPMENT FOR BOSTON ELEVATED.—With the additions at Lincoln Wharf, Harvard and Charlestown power stations of the Boston Elevated Railway Company, now nearing completion, the total generating equipment of the system will reach approximately 50,000 kilowatts. The work of laying out and constructing these station improvements was placed in the hands of the Stone & Webster Engineering Corporation, of Boston, in accordance with the recommendations made by this firm for a system of generation and distribution of power which would provide for present and future demands. It was decided to add 5400 kilowatts in equipment to the Lincoln Wharf Station, 2700 kilowatts to the Charlestown, and 2700 to the Harvard power station. Direct-current steam engine driven generators were selected as the type of the new units in order to conform in general design to those already installed in the various stations. The Lincoln Wharf power station, located on the harbor front, is the largest modern steam plant operated by the company. It supplies power for surface and subway cars operated in the heart of the Boston business district, as well as a large proportion of the power for the elevated system. The old station contained three 2700-kw, 375-volt units driven by vertical cross-compound engines. The additions to this station required an extension to the power house 83 ft. x 152 ft. The former boiler equipment was 6000 horse-power of Babcock & Wilcox boilers; the new equipment includes eight 600-hp boilers of the same make. The new power units, two in number, are 2700-kw Allis-Chalmers direct-current railway type generators driven by engines with cylinders 42 in. x 90 in. x 60 in. stroke at a speed of 72 r. p. m. These machines are multipolar, compound-wound type, 570 volts.

GREAT NOVEMBER EXPORTS.—The exports of merchandise during November touched the remarkable total of $204,445,000, figures never before approached in the history of American foreign trade. This readily explains why banking houses were able to bring in during the month the record total of $63,463,000 of gold. From the complete returns of the Government on November's trade it is found that the increase in agricultural exports was far larger than that in non-agricultural. The total shipments of agricultural products were $122,772,000, which compares with $99,977,000 in October last and $104,943,000 in November, 1906. The increase in wheat shipments amounted to $8,178,000 over those of the previous year, and the increase in breadstuffs alone made up $9,320,000 of the total increase of $17,820,000 in all domestic products. Cotton shipments were $7,000,000 heavier. It is understood that exports of copper were also heavy during the month, and that they, too, have had much to do with this fine trade showing. For the 11 months of the present calendar year the trade balance in our favor is $385,405,000, which is some $37,000,000 under that for the same period in 1906, but nearly $40,000,000 above the balance for the same 11 months in 1905.

CRANE ELEVATOR CHRISTMAS.—The Crane Elevator Company, following its custom, has given its 5000 employees 10 per cent of their salaries as a Christmas present. To do this the company gives its men $350,000. Each employee of one year's standing is entitled to share in this distribution of the profits. The sum given this Christmas exceeds by $20,000 the record of any other year since the company inaugurated its profit-sharing plan. In the eight years which have elapsed since the company adopted this policy it has paid its employees in gifts the sum of $1,850,000. Employees on the sick list or laid off temporarily because of slackness of work receive their share just the same.

EQUIPMENT FOR IRON MOUNTAIN, MICH.—The Iron Mountain Electric Light & Power Company, Iron Mountain, Mich., has lately let contracts for new electric generating and arc lighting equipment, comprising a 250-kw Allis-Chalmers alternating-current generator, three-phase, 60-cycle, 2300-volt; a 10-kw belted exciter, a five-panel switchboard, and 75 Adams-Bagnall arc lamps of the latest pattern. The generator is of the revolving field, two-bearing type, belt driven.

ALTERNATOR FOR CHICAGO, INDIANA & SOUTHERN RAILWAY COMPANY.—The Lake Shore & Michigan Southern Railway recently purchased a 250-kw Allis-Chalmers engine type generator, 240 volts, two-phase, 60-cycle, and a 15-kw exciter unit for addition to the power equipment of the Chicago, Indiana & Southern Railway Company, a subsidiary line. The new generator will be installed at Danville, Ill.

LARGE COPPER SHIPMENTS.—By the shipment of 18,000,000 lbs. of copper last week through New York exports of the metal to Europe for 11 weeks, including small amounts to China, approximate 167,000,000 lbs., of which total the United Metals Selling Company sent 73,142,397 lbs., or almost 50 per cent. A feature of the week was the large total sent out by the United Metals Company—14,000,000 lbs. of 18,000,000 lbs. total. One shipment by this concern in particular is worthy of mention, that being a consignment in one lot of 6,141,830 lbs. to Rotterdam. This pretty well cleans up the 100,000,000 lbs. sold by the company recently to foreign bankers.

FLEMING-HARRISBURG SALES.—Mr. A. M. Morse, the Chicago representative of Harrisburg Foundry & Machine Works, reports the following recent installations of Fleming-Harrisburg self-lubricating engines in Chicago territory: Minahan Office Building Company, Green Bay, Wis., one 400-hp, tandem compound standard engine, and one 250-hp standard. The Lak Shore Engine Works, Marquette, Mich., one 250-hp standard. Fleming Office Building Company, Des Moines, Ia., two 125-hp standard. Western Clock Manufacturing Company, La Salle, Ill., one 250-hp, four-valve. Geo. Ziegler Company, Milwaukee, Wis., one 180-hp. four-valve, and one 125-hp standard. Chicago, Burlington & Quincy Railway Company, West Burlington, Ia., one 300-hp, cross compound, four-valve. Armstrong Brothers Tool Company, Chicago, one 100-hp standard. Eastman Kodak Company, Chicago, one 150-hp, four-valve (second order). Congress Hotel Company, "Auditorium Annex," Chicago, two 600-hp and one 400-hp, all of four-valve type. St. Luke's Hospital, "George Smith Memorial," Chicago, two 250-hp, four-valve. American Bottle Company, Streator, Ill., one 250-hp standard (second order). Morrison Hotel & Restaurant Company, "Boston Oyster House," Chicago, one 250-hp, four-valve. Vendome Hotel, Chicago, one 100-hp standard. The above engines are, with one exception, of the direct-connected type, having the electric generator mounted alongside the fly-wheel on a massive steel main shaft, and they furnish electric energy for motor and lighting loads. Several thousand horse-power of Fleming-Harrisburg engines have been installed in "The Loop" district, in the heart of Chicago's business district.

BEAR LAKE POWER.—Advices from Pocatello, Idaho, state that Judge D. W. Standrod has recently inspected the plant of the Bear River Valley Railway & Electric Company, in which he is heavily interested. He has since authorized the statement that he has taken over the entire holdings of the company and will at once reorganize a corporation to be composed of some of the most prominent and wealthy men in the state. Judge Alfred Budge will be a member of the company. A number of important improvements will be made at the plant in Paris and the institution will be placed on a firm financial basis. J. A. Tupper, an experienced electric light man of Pocatello, formerly connected with the American Falls Power, Light & Water Company, has gone to Bear Lake to look after Judge Standrod's interests in the plant until the reorganization of the company is completed and permanent arrangements made for the appointment of a local manager.

ELECTRICAL CATALOGUES.—A member of a foreign legation located at Washington desires to receive American catalogues and price lists of a variety of articles, as his government makes extensive purchases of many goods in these classifications. Details can be had from the U. S. Bureau of Manufactures.

TELEPHONE SUPPLIES.—Tenders will be received at the office of the Deputy Postmaster-General, Sydney, New South Wales, for the supply and delivery, at the Central Exchange, General Postoffice, Sydney, Australia, of 1000 telephones, wall, common battery; 100 telephones, table, common battery.

Financial Intelligence.

THE WEEK IN WALL STREET.—Notwithstanding the maintenance of high money rates, the stock market showed a disposition to advance in an irregular way, though the strength was apparently due simply to covering of shorts. The declaration of the regular dividend of the New York Central and other roads contributed more or less to discourage bearish speculators. It is not considered that money conditions can improve sufficiently to encourage very marked bullish activity until after the disturbing influence of the January payments is out of the way. Beyond the developments of the Vanderbilt properties, there was little in the record of the week's events to seriously affect the market. The indications of continued but slow progress toward reëstablishment of normal financial conditions throughout the country were regarded with satisfaction, but this was offset by recognition of the narrow position of the local money market and the unwillingness of banks to finance anything like speculative operations. More or less attention continued to be given to the dividend payments and prospects of various companies. Little business was transacted in electric and traction stocks, but prices were firm. On the Curb, while prices were irregular, the closing quotations were at a substantial recovery from the early low level, and the volume of trading was a little larger. Following are the closing quotations of Dec. 23:

NEW YORK.

	Dec. 17	Dec. 23		Dec. 17	Dec. 23
Allis-Chalmers Co	5½	5⅞	General Electric 111		110
Allis-Chalmers Co. pfd..	15½	16½	Hudson River Tel.....	—	—
Am. Dist. Tel.....	20	39	Interborough Met. com..	6½	6½
American Locomotive...	34¼	37	Interborough Met. pfd..	16	17¼
Amer. Locomotive pfd..	86½	88	Mackays Cos.	50¾	51
American Tel. & Cable..	—	50	Mackays Cos. pfd.....	58	59⅛
American Tel. & Tel...100¼		101	Marconi Tel.	—	—
Brooklyn Rapid Transit.	37¾	38¾	Metropolitan St. Ry.....	21	—
Electric Boat	—	—	N. Y. & N. J. Tel.....	94	94
Electric Boat pfd.....	—	—	Western Union Tel.....	55½	55
Electric Vehicle	—	—	Westinghouse com.....	40¼	43⅛
Electric Vehicle pfd....	—	—	Westinghouse pfd.....	65	60

BOSTON.

	Dec. 17	Dec. 23		Dec. 17	Dec. 23
American Tel. & Tel...101		101½	Mass. Elec. Ry. pfd....	37	—
Cumberland Telephone..	—	—	Mexican Telephone.....	—	1¼
Edison Elec. Illum.....208		—	New England Telep.....	—	105
General Electric	—	—	Western Tel. & Tel.....	—	—
Mass. Elec. Ry.....	—	—	West. Tel. & Tel. pfd...	—	—

PHILADELPHIA.

	Dec. 17	Dec. 23		Dec. 17	Dec. 23
American Railways.....	43	43	Phila. Electric	6¼	6¼
Elec. Co. of America...	8⅞	9¼	Phila. Rapid Transit....	17	17
Elec. Storage Battery...	28	27	Phila. Traction	82⅝	82½
Elec. Stor. Battery pfd..	—	—			

CHICAGO.

	Dec. 17	Dec. 23		Dec. 17	Dec. 23
Chicago City Ry.....150*		150*	National Carbon	—	—
Commonwealth-Edison ...	—	78	National Carbon pfd....	—	—
Chicago Subway	15⅝	15½	Union Traction	—	—
Chicago Tel. Co.....109		105	Union Traction pfd....	—	—
Metropolitan Elec. com..	16½*	16½			

*Asked.

DIVIDENDS.—The Havana Electric Railway Company has declared a dividend of 1½ per cent on the preferred stock, payable Jan. 15. American Locomotive directors have declared the regular quarterly dividends of 1¾ per cent on the preferred stock and 1¼ per cent on the common stock. The preferred dividend is payable Jan. 21. The common dividend is payable Feb. 26. Directors of the Evansville Light Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable Jan. 2. Directors of the Bell Telephone Company, of Philadelphia, have declared the regular quarterly dividend of 1½ per cent, payable Jan. 15 to stock of record of Jan. 4. J. G. White & Company, Inc., have declared the nineteenth regular quarterly dividend of 1½ per cent on the preferred stock, payable Jan. 2. The Washington Water Power Company has declared a quarterly dividend of 1¾ per cent, payable Jan. 2. The Union Switch & Signal Company has declared the regular quarterly dividend of 3 per cent on the common and preferred stock. The El Paso Electric Company, of Texas, has declared a semi-annual dividend of 3 per cent on the preferred stock, payable Jan. 13. The Narragansett Electric Company, of Providence, R. I., has declared a quarterly dividend of $1 per share, payable Jan. 2. The San Paulo Tramway, Light & Power Company, Ltd., has declared a quarterly dividend of 2¼ per cent, being an increase of ¼ per cent. The Puget Sound Electric Company has declared a semi-annual dividend of $3 per share on the preferred, payable Jan. 1. The Manchester, N. H., Traction, Light & Power Company has declared a regular quarterly dividend of 1 per cent, payable Jan. 15. Directors of the Electric Boat Company have declared the regular quarterly dividend of 2 per cent on the preferred stock and a dividend of 2 per cent on the common stock. A dividend of 2 per cent on the common stock was declared a year ago. The common dividend is payable Dec. 31. The preferred dividend is payable Jan. 2. The American Telephone & Telegraph Company has declared the regular quarterly dividend of 2 per cent, payable Jan. 15. The directors of the United Traction Company, of Pittsburg, have declared the regular semi-annual dividend of 2½ per cent on the preferred stock, payable Jan. 20. Directors of the Cincinnati Street Railway Company have declared the regular quarterly dividend of 1½ per cent, payable Jan. 1. Directors of Manning, Maxwell & Moore, Inc., have declared the regular quarterly dividend of 1½ per cent, payable Dec. 31. Directors of the Twin City Rapid Transit Company have declared a quarterly dividend of 1¾ per cent on the preferred stock, payable Jan. 2. The Tri-City Railway & Light Company has declared a dividend of 1½ per cent on the preferred stock, payable Jan. 2. The United Traction & Electric Company has declared a dividend of 1¼ per cent on the capital stock, payable Jan. 2. The trustees of the Massachusetts Lighting Companies have declared a regular quarterly dividend of 1½ per cent, payable Jan. 15. Directors of the Manila, P. I., Electric Railroad & Lighting Corporation

have declared a quarterly dividend of 1 per cent on the capital stock, payable Jan. 2. E. W. Bliss Company has declared quarterly dividends of 2 per cent on the preferred stock and 2½ per cent on the common, payable Jan. 2. Directors of the Michigan Light Company have declared quarterly dividends of 1¼ per cent on the common and 1 per cent on the preferred, payable Jan. 2. Directors of the U. S. Telephone Company have declared a regular quarterly dividend of 1½ per cent on the preferred, payable Feb. 15. Directors of the Mexican Telegraph Company have declared a regular quarterly dividend of 2½ per cent on the capital stock, payable Jan. 15.

MASSACHUSETTS ELECTRIC REPORT.—The annual report of President Abbott, of the Massachusetts Electric Companies, owning traction and lighting properties, says: "The net results have been nearly identical with those of last year. There has been a certain amount of variation in the items—gross earnings increased $240,270, winter expenses were larger, cost of accidents was smaller—but the final result of all these variations is that net divisible income increased $15,050; or, in other words, remained substantially the same as last year." The surplus after dividends, however, was much smaller, amounting to only $174,462, against $329,779 in 1906 and $361,862 in 1905. The consolidated income account of the consolidated companies compares as follows with the previous year:

	1907.	1906.
Gross earnings	$7,758,511	$7,518,240
Expenses	5,000,652	4,883,552
Net earnings	$2,757,858	$2,634,688
Charges	1,702,622	1,594,502
Balance	$1,055,235	$1,040,185
Dividends	880,773	710,406
Surplus	$174,462	$329,779

The profit and loss statement of the parent company is as follows:

	1907.	1906.
Dividends on stock owned	$880,837	$710,498
Miscellaneous interest on notes	82,003	66,651
Total income	$962,840	$777,149
Total expenses	16,629	18,305
Net income	$946,211	$758,754
Interest on notes	157,500	157,500
Surplus	$788,711	$601,254
Total surplus	1,566,884	778,173

The report 'adds: "The freight and express business has shown a gratifying increase on those parts of the Old Colony where it has been put in operation, but it has not been possible even yet to secure all the necessary rights to carry freight over the whole of that system. With respect to the physical condition of the property, it has improved over that of last year. Liberal charges to operating expenses for maintenance have been supplemented by the expenditure of $1,574,680 for construction, reconstruction and the purchase of additional rolling stock and other property. Whether or not it will be judicious to spend during the coming year the balance required to complete the reconstruction of the property, will depend upon the general business situation and the trustees do not intend to approve of any considerable new expenditures until that situation shall be clearer than it is at present. It was of the utmost importance that the work outlined two years ago should be done as quickly as possible. Without it the system could not have been operated economically and successfully. And in view of the developments of the general financial situation during the past year, the trustees are of the opinion that the wisdom of omitting the payment of dividends has been sufficiently demonstrated. The failure to pay dividends during the past year was not due to lack of earning power or to disastrous losses from accidents. The earning power has proven excellent. The trustees expect that when the operating companies shall have completed the reconstruction of their property they will be in such physical condition as to require only ordinary annual expenditures for maintenance and reconstruction, and that they will then be able to finance their needs without drawing from the treasury of the Massachusetts Electric Companies the dividends they pay in."

BOSTON AND BELL CONTROL.—Advices from New England say: "Financial Boston has been disturbed during the past month by the reappearance of the rumors that control of the American Telephone & Telegraph Company had finally and definitely passed to New York. The old rumor in a new garb is to the effect that the decline in the stock to below 90 resulted in the forced liquidation early this month of some very large New England accounts which have been transferred to New York parties, giving to the New York interests enough stock to insure the supplanting, at the annual meeting in March, of certain of the present directors who have held over from the day of the old American Bell Company. Further than this, New York control is to be emphasized by the dominance of the Mackay interests in the affairs of the telephone company, thus marking the consolidation in fact of the telephone and a large part of the telegraph business of the country. The facts of the situation make altogether different reading, and are of a sort to allay much of the doubt regarding the future course of telephone affairs. There has been no transfer on the books of the American Telephone Company of any large block, or series of large blocks, of stock either this month, or last month, or for several months preceding. Instead of marking the passing of stock control to New York the decline in the stock to 89¼ actually resulted in giving New England a greater measure of control than ever before. Over 1500 names have been added to the list of stockholders since Nov. 1, a large majority of whom are New Englanders. The American Telephone Company has at present over 23,000 stockholders, an increase since Jan. 1 of over 500 names.

SOUTHERN BELL TELEPHONE.—The annual report of the Southern Bell Telephone Company, just filed with the South Carolina Railroad Commission and embodied in the board's coming report to the Legislature, is an interesting recapitulation. Cost of real estate and buildings, $34,732.30; cost of equipment, $1,097,783.23; cost of toll construction, $437,462.43. Total cost, $1,551,982.96. Gross income from subscribers, $303,254.88; long distance, $51,555.48. Total, $364,810.38. Cost of operation, general expenses, $61,719.43; salaries paid, $130,615.60; maintenance, $66,375.89; taxes paid, $13,203.87; dividends paid, none. Total, $271,914.79.

RUTLAND, VT., EARNINGS.—The annual report of the Rutland Railway, Light & Power Company for the twelve months ended November 30, 1907, shows total gross earnings for all companies of $224,361, an increase of $39,315, and net earnings of $104,459, an increase of $23,807. While the gross earnings of the Power Company for the year are given in the detailed report at $36,678, it should be noted that comparison is made with the earnings for nine months in the previous year, which amounted to $12,412.

UNITED STATES TELEPHONE.—The United States Telephone Company's statement for the month of October and ten months compares as follows:

	1907.	1906.		
October gross	$39,656	$34,750	Inc.	$4,906
Expenses	12,953	12,396	Inc.	557
October net	$26,703	$22,354	Inc.	$4,349
Ten months' gross	$385,199	$356,811	Inc.	$28,388
Expenses	154,709	144,719	Inc.	9,990
Ten months' net	$230,490	$212,092	Inc.	$18,398

CANADIAN BELL.—Advices from Winnipeg, Manitoba, Canada, state that Mr. C. F. Sise, president of the Bell Telephone Company, of Canada, has been in Winnipeg conferring with the Manitoba Government relative to disposing of the entire Bell lines in the province to the government. The provincial government has established a complete public system throughout Manitoba, driving the Bell interests to negotiate, leaving a government monopoly in the field.

WESTINGHOUSE AIR BRAKE.—The directors of the Westinghouse Air Brake Company have declared the regular quarterly dividend of 2½ per cent and an extra dividend of 2½ per cent, both payable January 31, 1908. The directors also acted on the resolution of the stockholders, passed Dec. 3, increasing the capital stock from $11,000,000 to $14,000,000. Out of the increase a 25 per cent stock dividend was declared.

BELL TELEPHONE OF PENNSYLVANIA.—The Bell Telephone Company, of Philadelphia, has filed notice at Harrisburg of an increase of its capital stock from $30,000,000 to $60,000,000, and of a change of name to "Bell Telephone Company of Pennsylvania." These changes are due to the absorption of the Pennsylvania Telephone Company and the Delaware & Atlantic Telephone Company.

BRITISH WESTINGHOUSE.—The managing director of the British Westinghouse Company has cabled that the holders of the debenture stock of the British company have authorized the issue of preference debentures upon the proposition to issue $1,500,000 of 4 per cent preference debenture stock.

GENERAL NEWS

Construction News.

DADEVILLE, ALA.—Bids will be received until Jan. 10 by the Town Council for $8,500 in bonds to pay for additional equipment and for improvements to the municipal electric light and power plant. J. B. Rylance is Mayor.

HARTFORD, ALA.—The citizens are contemplating making extensions to both the water and light plants during the next year. W. H. Whatley is superintendent.

TROY, ALA.—The Pea River Power Company is planning to develop water power on the Pea River at this point and will erect a 3000-hp plant. The company owns seven miles of water rights, and 100 feet of right of way from its power site to Elba. H. D. Boyd is secretary and treasurer.

FLORENCE, ARIZ.—A special election will be held here on Feb. 8 to vote on the proposition of granting the Florence Water, Light & Ice Company a franchise to construct and operate a water and light plant in the town. J. E. O'Connor is town clerk.

DE QUEEN, ARK.—The De Queen Light, Ice & Cold Storage Company is contemplating establishing a day service and installing meters. Paul Coleman is manager.

FORDYCE, ARK.—The Fordyce Light & Water Company is contemplating the construction of a new station. C. A. Parsons is manager.

LITTLE ROCK, ARK.—Contracts have been awarded for the grading for the Little Rock & Pine Bluff Traction Company's interurban railway between Pine Bluff and Little Rock. W. H. Langford is vice-president.

SPRINGDALE, ARK.—The Springdale Electric Light & Power Company has been granted a franchise to erect and operate an electric light plant in Springdale for a term of 25 years.

FAIRFIELD, CAL.—E. D. N. Lehe, of Dixon, is contemplating the construction of a transmission line up the valley from the sub-station near Cordelia.

HOLTVILLE, CAL.—The Holton Power Company is contemplating increasing the equipment of its plant by the installation of two 300-kw alternating-current generators direct-connected to water wheels. C. E. Paris, of El Centro, is general superintendent.

NEVADA CITY, CAL.—A local report states that the Southern Pacific Company has surveyors at work on the watershed between Sierra City and Downieville, and that the company has water rights and has staked out flumes and ditches which will give it a fall of 1100 feet, to furnish a series of power houses from which electrical energy will be furnished for the operation of the railroad over the Sierras. It is claimed that these water rights are located in the Tahoe forest reserve and cannot be obtained from the Government.

ONTARIO, CAL.—Charles Frankish, of this city, is interested in a project to build an electric railway to run from Ontario through Pomona and Chino, to Newport Beach, a distance of 35 miles. A company, under the name of the Ontario Interurban Railway Company, is being organized with a capital stock of $500,000 to carry out the project. Rights of way are now being secured.

RIVERSIDE, CAL.—Work will soon commence on the construction of the electric railway to connect Riverside and Colton. The franchise was awarded a year ago to the San Bernardino Valley Interurban Railway Company under the name of A. C. Denman, Jr. The road will be nine miles long.

SAN BERNARDINO, CAL.—The Lytle Creek Power Company is erecting a new circuit to furnish electricity for heating and lighting in residences. F. A. Worthley is manager.

SAN BERNARDINO, CAL.—The franchise to be used by the Home Gas & Electric Company, of Redlands, in connecting up its plant with the Lytle Creek Company in this city, was sold to C. S. Chesnut for $42. The franchise is over the county roads between the two cities.

DELTA, COL.—The Delta Electric Light Company is contemplating the installation of a 100-hp engine and an alternating-current generator. J. E. Shue is treasurer and manager.

DENVER, COL.—The Summit County Power Company is constructing a hydro-electric power plant near Dillon, and will furnish electricity for the mines and mills in Summit County. The first installation will have a rating of 1500 kw. The company expects to have the plant in operation about April 1, 1908. W. C. Sterne is vice-president and general manager.

PUEBLO, COL.—The Pueblo & Arkansas Electric Railroad Company has been chartered with a capital stock of $300,000 by M. J. Verner, Lester Wolf and others. The company proposes to construct an electric railway from Pueblo to Fowler down the Arkansas Valley.

STERLING, COL.—The Sterling Public Service Company will install during the summer of 1908 one unit of about 200-kw, 2200-volt, 60-cycle, three-phase, revolving field generator, direct-connected to a Corliss engine. T. M. Crane is superintendent.

HARTFORD, CONN.—The Hartford City Gas Light Company is considering the question of constructing an electric light plant in connection with the gas works on Arch Street. E. B. Bennett is president.

MANCHESTER, CONN.—The Glastonbury Power Company is changing the system in Manchester from 1040-104-volt, single-phase, 133 cycles, to 2300-230-115-volt, three-wire, three-phase, 60 cycles. The company has leased the plant of the Manchester Light & Power Company and at present is purchasing power. M. S. Bradley is secretary.

SOUTH MANCHESTER, CONN.—The Spring Silk Company is installing an electric plant to operate its plant by electricity.

THOMASTON, CONN.—The Thomaston Electric Light Company has notified its patrons that after Jan. 1, 1908, all flat rates for lighting service will be discontinued and all lighting service will be furnished at meter rates.

ATLANTA, GA.—The Georgia Railway & Electric Company is making plans to commence work on the extension of its lines to Buckhead in the near future, for which the board of directors has voted an appropriation.

CARROLLTON, GA.—The Carrollton Electric Company is making estimates on the cost of installing a three-phase alternator and Corliss engine; also starting a day service some time next year. J. G. Cheney is manager.

MADISON, GA.—Bids will be received by E. W. Butler, Mayor, until Dec. 31, for $50,000 water works, electric light and sewerage bonds.

SAVANNAH, GA.—The Savannah Lighting Company is contemplating installing a 500-kw steam turbo-generator set in February or March. S. Brown is superintendent.

WALLACE, IDAHO.—The Cœur d'Alene Power Company has completed arrangements to commence work on its plant near Wallace, and work will soon begin on the erection of the building, which it is expected will be completed soon after the first of the year. The cost of the buildings is estimated at $10,000. The equipment will be installed as soon as the buildings are completed.

POCATELLO, IDAHO.—The Idaho Consolidated Power Company contemplates the installation of a 2500-hp horizontal turbine water wheel. F. C. Stanford is manager.

CLINTON, ILL.—The gas, electric light and steam heating plants in this place have been sold by the Gas & Electric Development Company to a new company, organized by Philadelphia, Easton and Harrisburg, Pa., capitalists, under the name of the Clinton Gas & Electric Company. The capital stock of the new company is placed at $150,000. The new owners are contemplating many extensions and improvements to the plants.

DANVILLE, ILL.—The Danville & Southern Railway Company has filed an application with the City Council for a franchise to operate an electric railway from the public square to the city limits on the Perryville Road.

FISHER, ILL.—The town of Fisher has purchased the local electric light plant from J. W. Kidd for $6,200. The plant will be managed by the town board and will furnish more lamps for the streets.

SYCAMORE, ILL.—The Board of Supervisors of De Kalb County has granted the Exchange Telephone Company a franchise to do business in this county.

COLUMBUS, IND.—The City Council is advertising for bids for furnishing and installing two horizontal 150-hp boilers at the water works plant.

CRAWFORDSVILLE, IND.—A proposition has been submitted to the City Council for the reconstruction of the municipal electric light plant. The promoters offer to rebuild the plant and make it as good as new. They propose to organize a trust company guaranteeing to rebuild the plant and turn it over to the city. The city is to pay for the reconstruction in ten annual payments. At the end of ten years the plant is to be turned over to the city without further cost.

FORT WAYNE, IND.—George Krudop is erecting a planing mill in this city and installing modern machinery, which is to be driven by four electric motors. Electricity for operating the mill will be supplied by the traction company.

FRANKFORT, IND.—The city is contemplating installing a 600-kw generator, direct-connected to a cross-compound engine in the municipal electric light plant. W. H. Carter is superintendent.

GREENCASTLE, IND.—Paul H. White, of Indianapolis, has applied to the City Council for a franchise empowering his company to erect a high-tension transmission line through this city to furnish electricity for lamps and motors. The company contemplates the construction of a large power plant in the Indiana coal fields, in Vigo County, to generate electricity to be transmitted to Indianapolis. Frank M. Fauvre, of Indianapolis, is interested in the enterprise.

MONTICELLO, IND.—The Tippecanoe Electric & Power Company, a new organization recently incorporated with a capital of $75,000, will commence at once the development of the water power in the Tippecanoe River. The company has secured control of the dam and water power

in this city now used for a flouring mill, and will erect a new building and install new machinery for the generation of electricity. The dam will also be reconstructed and raised at least four feet higher. In addition to furnishing street and commercial lighting, for which it has secured a franchise in this city, the company will also furnish electricity for motors. The directors of the new company are Abraham S. Strauss, Henry Meyers and J. Garrett Smith, all of Chicago, Ill. Mr. Strauss is president of the newly projected traction line to be built from Frankfort to Chicago, via Monticello, and this plant is expected to furnish part of the energy for operating the road.

PRINCETON, IND.—The Cumberland Telephone Company is making extensive repairs and improvements to its system in this city and has applied to the City Council for an extension of time from Jan. 1 to May 1, 1908. It is the purpose of the company to install a central energy system, with the latest improved equipment. The company has also leased another building in which the exchange will be moved.

RICHMOND, IND.—The committee appointed by the City Council and Commercial Club to investigate the municipal lighting plant has reported advising that the plant be not sold to the Richmond Light & Power Company. The report of the plant for November shows the receipts to have been $6,652.27 and the expenditures $3,922.32.

TERRE HAUTE, IND.—The Terre Haute & Merom Traction Company has awarded the contract for the construction of its road to the Central States Construction Company, of Chicago, Ill. The road will be about ten miles in length and will extend from Terre Haute to Merom, Ind., and also to Robinson, Ill. The officers of the company are L. Brown, president, J. Warren Brown, secretary, and H. L. Bartlett, of St. Louis, Mo., treasurer.

TIPTON, IND.—The Tipton Electric Light Company is considering the question of installing a 500-hp water tube boiler in its plant next year. J. H. Stewart is manager.

WARSAW, IND.—A committee has been appointed to inquire into the feasibility of purchasing the Winona Water & Light Company's plant, which has furnished the city with water for many years and with light for a number of years. The company recently submitted a report to the City Council acknowledging a loss of $5,400 during the past eleven months.

ALBIA, IA.—The Albia Interurban Railway Company has commenced operating its line in Albia and to the Hocking, three miles south of the city. It is the present intention of the company to continue the railway to Hiteman, six miles north, and on to Buxton, 12 miles distant, in the same direction, work on which will commence early in the spring. John P. Reese is president of the company.

ATLANTIC, IA.—At a meeting of the stockholders of the Atlantic & Northern Interurban Railway Company, held recently, it was decided to construct an extension from Atlantic to Villisca, a distance of about 38 miles. The officials of the company were authorized to make the necessary preliminary surveys, prepare plans and specifications and report at the next meeting of the stockholders.

FORT DODGE, IA.—The Spirit Lake, Emmetsburg & Fort Dodge Railway Company is planning to begin construction work in the near future. The railway will be about 110 miles long and will connect Fort Dodge, Spirit Lake, Emmetsburg and intervening cities and towns. The company will furnish electricity to towns along the route. T. F McCartan, of Pocohontas, is president.

OSAGE, IA.—The Osage Electric Light, Heat & Power Company is planning to install an additional water wheel soon. Thomas Ferris is manager.

SPENCER, IA.—Plans are being made for extensive additions and improvements to the municipal electric light plant, including the installation of a direct-connected unit with a rating of about 60 kw, or a Corliss engine and generator of the same rating, belted; also a new 150-kw generator. Both units will be three-phase, 2300-volt, 60 cycles. A new switchboard, boiler feed pumps, heater, etc., will also be installed. R. L. Taylor is manager.

HARPER, KAN.—We are informed that the city contemplates the installation of an additional generator and two new boilers in the municipal electric light plant in the spring or summer. Horace A. Lee is superintendent.

CENTRAL CITY, KY.—The Central City Light & Power Company is contemplating increasing the equipment of its plant for the purpose of furnishing a day service to operate fans next summer. T. Q. Fortney is manager.

LECOMPTE, LA.—W. H. Jones, city clerk, writes that bids will probably be received about Feb. 1 for the construction of an electric light plant to cost about $10,000. Baldwin Wood, of New Orleans, is engineer in charge of construction of plant.

MINDEN, LA.—H. A. Davis and J. B. Story have applied to the Town Council for a franchise to operate a street railway franchise in the town of Minden.

OPELOUSAS, LA.—The city has recently placed an order for a 25-kw, 125-volt, direct-connected generator, to be belted to an engine now in use in the municipal electric light plant, to furnish energy for a 25-hp vertical Westinghouse motor, direct-connected to a Platt Iron Works turbine pump, to be used in connection with the city water works system. A. C. Jones is superintendent.

LEWISTON, ME.—We are informed that the Lewiston, Augusta & Waterville Street Railway Company is planning to place contracts during the next two months for the construction of two sub-stations, and also the purchase of two semi-convertible cars. E. D. Reed is general manager.

CRISFIELD, MD.—We are informed that the Crisfield Ice Manufacturing Company will make extensive additions and improvements to its plant, including the installation of new engines, dynamos and boilers; also 10 miles of line extension. C. O. Mills is chief engineer.

FREDERICK, MD.—The city has recently ordered another dynamo to be installed in the municipal electric light plant to furnish electricity for incandescent lamps, which will be used to light the city opera house and the municipal offices. If this experiment proves successful the city may enlarge the municipal plant and go into a general lighting business.

HOLYOKE, MASS.—The Board of Aldermen on Dec. 17 authorized the lighting department to secure a loan of $160,000 for additions and improvement to the municipal electric light station. The plans contemplate the purchase of a turbo-generator set, the rearrangement of the steam system and enlarging the storage room to hold 1000 tons of coal instead of the 200 as at present.

LYNN, MASS.—The City Council has entered into a contract with the Lynn Gas & Electric Company for lighting the city for a term of five years. The contract provides for 300 or more arc lamps and 1200 or more incandescent lamps. The arc lamps are to be of the enclosed alternating-current type of 2000-cp each, with an all-night service, the service to be charged for at the rate of $94.90 per lamp per year for the first three years of the contract, and $91.25 each per year for the remaining two years. The price for the past two years has been $98.55 each per year. The rate for incandescent lamps is to be $15.50 per lamp per year for the first three years and $15 each for the remaining two years. The present price is $16 each per year.

NEW BEDFORD, MASS.—The New Bedford Gas & Edison Light Company contemplates making extensions to its electric lighting system. Charles R. Price is treasurer.

PLYMOUTH, MASS.—The Plymouth Electric Light Company is making arrangements for substituting 32-cp tungsten filament lamps for the 25-cp carbon filament series incandescent lamps now in use. E. P. Roweel is superintendent.

BELLAIRE, MICH.—The citizens are contemplating increasing the output of the municipal electric light plant and will raise the dam next season, putting in a cement core, cement flume and bulkhead. Charles J. Evans is superintendent.

KALAMAZOO, MICH.—It is reported that the City Council is contemplating installing an alternating-current system in the municipal electric light plant next spring.

LINDEN, MICH.—The Village Council is considering the question of lighting the streets by electricity to be transmitted from Fenton.

MANCELONA, MICH.—The Antrim Light & Power Company is contemplating increasing the output of its plant. F. R. Joslin is manager.

MASON, MICH.—The managers of the municipal electric light plant are endeavoring to secure entire new equipment for the plant, but nothing can be decided until after the election in the spring. T. J. Rapp is superintendent.

SAULT STE. MARIE, MICH.—We are informed that the Edison Sault Electric Company is contemplating the installation of a new dynamo in its plant next spring. Alexander Dow is manager.

BLACKDUCK, MINN.—The Blackduck Electric & Telephone Company is in the market for a 35-kw, 250-volt, direct-current outfit with compensating set, or outfit to work on three-wire system of 125 and 250 volts. C. W. Jewett is vice-president and general manager.

FARIBAULT, MINN.—The Faribault Gas & Electric Company contemplates the installation of a producer gas engine plant. B. W. Cowperthwait is secretary and manager.

NAUSHWAUK, MINN.—The Village Trustees are receiving bids for the installation of an engine, 80-kw, alternating-current generator, switchboard, etc. G. A. Lindsay is manager.

OSAKIS, MINN.—The Osakis Milling Company is contemplating increasing the output of its plant to meet the increased demand for electricity. About 75 horse-power will be needed. William A. Olen is local manager.

ST. PETER, MINN.—Plans are being made to change the system of the municipal electric light plant from single-phase, 1000-volt, to three-phase, 2300-volt, and from belted to direct-connected machines. H. A. Hildebrandt is superintendent.

WASECA, MINN.—The Water and Light Board is contemplating changing the system of the municipal electric light plant from direct to alternating current in the spring. E. G. Guy is superintendent. 2

CORINTH, MISS.—The Corinth & Shiloh Electric Railway Company is contemplating the construction of an electric railway from Corinth to the National Park at Shiloh. The road will be 22 miles long and an overhead trolley system will be installed. The authorized capital stock of the company is $250,000, and the officers are A. Rubel, of Corinth, president; S. H. Rubel, vice-president and treasurer; M. T. Bynum, secretary, and W. J. Lamb, general manager.

GULFPORT, MISS.—The Gulfport & Mississippi Coast Traction Company has placed contracts for one 1500-kw Westinghouse turbine and Babcock & Wilcox boilers and accessories. W. F. Garenflo is manager.

MAGNOLIA, MISS.—The Magnolia Electric Light Company is contemplating installing a 100-kw generator and a 150-hp high-speed engine in its plant. Xavier A. Kramer is superintendent.

PONTOTOC, MISS.—The Pontotoc Light & Power Company is contemplating increasing the equipment of its plant and will install an 85-hp tubular boiler and establish a direct-current day service. R. L. Campbell is manager.

HIGGINSVILLE, MO.—The citizens are contemplating rebuilding the overhead system of the municipal electric light plant. Frank Monser is superintendent.

LEES SUMMIT, MO.—L. Schreechfield & Son, owners of the electric light plant, are negotiating with the town of Greenfield, four miles distant, to furnish electricity for lighting in that town.

MARYVILLE, MO.—The Maryville Electric Light & Power Company is changing its system from 133 to 60 cycles. J. C. Donnell is manager.

NEVADA, MO.—C. C. McFann, general manager of the Kansas City & Springfield Southern Railway, reports that surveys have been completed for the proposed electric railway between Nevada and Springfield with a branch line to Carthage. The road will be 140 miles long, including sidings, and will be operated by electricity. The power station will be located near Arcola. The company also contemplates establishing an amusement park near the Sac River. W. B. Forsyth is president.

ANACONDA, MONT.—The Montana Independent Telephone Company will soon commence construction work on its new plant in this city, and expects to have it in operation by Feb. 15.

COLUMBUS, NEB.—It is reported that a new electric light and power plant will be erected in this city in the near future.

EXETER, N. H.—Owing to an increase in demand for electricity for operating motors, the Exeter, Hampton & Amesbury Street Railway Company has been compelled to erect new transmission lines from the power house in Hampton to Exeter and through the town, to relieve the lines used for commercial lighting.

HAMMONTON, N. J.—The Hammonton Electric Light Company is planning to remodel its street lighting system in the spring. P. H. Garrison is superintendent.

PARK RIDGE, N. J.—The electric light committee is planning to install a gasoline engine and an additional generator in the municipal electric light plant to be used as an auxiliary, and also plans to raise the dam to secure more water power, and to extend its transmission line through the next town, for which it has a contract to furnish light. E. Vernon Smith is superintendent.

TRENTON, N. J.—Bids will be received until Dec. 31 by J. Willard Morgan, State Comptroller, for furnishing electricity needed for lamps and motors in and about the State House, for a period of three or five years. The maximum current required will be 1500 amperes, 110 volts, alternating-current, 60-cycle, single-phase for lighting purposes and desk fan motors; for elevators, motors, shops, blower fans, etc., the maximum current required will be 200 amperes, 220 volts, direct current. Bids must be submitted on a net flat meter rate for both classes of service.

CROTON FALLS, N. Y.—George Juengst & Sons, owners of the Croton Falls electric light plant, are contemplating the reconstruction of the plant and system at Brewster and Purdys. George Juengst, Jr., is manager.

GOUVERNEUR, N. Y.—The Hannawa Power Company has purchased the Gardner property on the west side and will construct a transforming station on that site. The property is located near the marble quarries, which the company expects to furnish with electrical power.

LIMA, N. Y.—The Lima-Honeoye Electric Light & Railroad Company contemplates extending its line eleven miles north to Rochester, and to Atlanta, 15 miles south, during the year of 1908. The company also expects to install a power plant in its gas field in Lima to furnish electric energy for all purposes. E. D. Watkins is manager.

LIVINGSTON MANOR, N. Y.—The Livingston Manor Electric Company is building a concrete dam, 1400 feet of pipe line 20 inches in diameter and installing two 60-hp impulse water wheels. W. R. Woolsey is treasurer.

NEWPORT, N. Y.—The Newport Electric Light & Power Company contemplates extending its lines to Poland and Cold Brook in the spring. The Public Service Commission has granted the company permission to issue $60,000 in bonds, the proceeds to be used for extensions to its system. James B. Crane is manager.

NEW YORK, N. Y.—The Otis Elevator Company, of New York City, has secured the contract for flash-light signals for the elevators at the New York Custom House for $7,280.

OSSINING, N. Y.—The Northern Westchester Lighting Company is installing an additional 500-kw turbine and erecting a 13,000-volt, three-phase transmission line to Peekskill. Stuart Wilder is vice-president and manager.

RHINEBECK, N. Y.—The Dutchess Light & Power Company is contemplating making some line extensions in the spring. R. Raymond Rikert is manager.

ROSLYN, N. Y.—At a special meeting of the stockholders of the Nassau Light, Heat & Power Company, held Dec. 19, the proposition to issue $1,000,000 in bonds was ratified and confirmed.

ASHEVILLE, N. C.—The contract for the construction of the interurban electric railway between Asheville and Hendersonville has been awarded to the Carolina Construction Company.

BURLINGTON, N. C.—The Burgrahaw Traction Company has been granted a franchise by the Board of Aldermen to construct and operate a street car system in the city of Burlington for a term of 60 years. J. N. Harden, J. M. Cook and J. W. Murray are the promoters of the enterprise.

FAYETTEVILLE, N. C.—E. G. Maxwell, manager of the Cape Fear Electric Power Company, has announced that the plant will be finished by Jan. 1, 1908, and that electricity will be furnished to mills and foundries in this city. About 4000 horse-power will be available at first, which will be increased later.

ROCKY MOUNT, N. C.—The city has voted bonds to the extent of $80,000 for the construction of an entire new electric light plant and improvements to water works. The bonds are yet unsold, but when sold the city will be in the market for electrical machinery, engines and boilers. A. S. Lyon is superintendent.

WASHINGTON, N. C.—P. A. Tillery, superintendent of the municipal electric light plant, writes that the city will establish a day service about April 1, 1908.

EDGELEY, N. D.—The citizens are considering the question of installing an electric light plant in connection with the proposed water pumping plant.

FOSTORIA, OHIO.—The Lake Shore Electric Railway Company has entered into a contract with the Toledo, Fostoria & Findlay Electric Railway Company to furnish electricity to operate its road. A high-tension transmission line will be erected from Woodville to a sub-station at Pemberville, where a 400-kw rotary converter has been installed. The Lake Shore company will also furnish electricity for operating the Norwalk-Shelby line, and a portion of the Cleveland, Southwestern & Columbus railway between Lorain and Amherst.

GIBSONBURG, OHIO.—It is reported that the Toledo, Fostoria & Findlay Electric Railway Company is considering plans to build an electric railway from Gibsonburg to Jersey City by the way of Bradnor and Prairie Depot. It is said that the road will be built the coming summer.

MANSFIELD, OHIO.—The capital stock of the Massillon, Wooster & Mansfield Traction Company has been increased from $1,000 to $1,000,000.

MOUNT HEALTHY, OHIO.—The Village Council has granted the Fitzsimmons & Associates Telephone Company a 25-year franchise to operate a telephone system in this village.

SALEM, OHIO.—The Salem Electric Light & Power Company contemplates building a new plant next spring. D. L. Davis is secretary and manager.

WAUSEON, OHIO.—H. H. Williams & Company, owners of the Wauseon electric light plant, contemplate installing new boilers in their plant to take the place of the ones now in use. W. F. Hubbell is treasurer and manager.

CHEROKEE, OKLA.—The Cherokee Ice & Power Company contemplates the installation of a 90-kw alternating-current generator in its plant. Robert T. Lyon is manager.

PORTLAND, ORE.—Plans are being contemplated by A. Welch and the Willamette Valley Company for the construction of an electric railway from Portland to Salem, Eugene, Prineville, Yaquina and Ontario, with branches to numerous towns. The company will be incorporated under the name of the Portland, Eugene & Eastern Railway Company with a nominal capital stock of $1,000,000.

ALTOONA, PA.—F. G. Patterson, of Pittsburg, promoter of the Altoona, Hollidaysburg & Bedford Traction Railroad, states that arrangements have been made for furnishing capital to complete the line from Altoona to Newry at once, but owing to the stringency in money matters, it has been decided to postpone the work until next spring.

BLAIRSVILLE, PA.—The Citizens' Heat, Light & Power Company contemplates the installation of an 80-arc dynamo in its plant. R. H. Wiggins is secretary.

CHAMBERSBURG, PA.—It is stated that the Cumberland Valley Railroad Company will equip the Waynesboro branch for electrical operation within the next six months or next year.

GETTYSBURG, PA.—The Keystone Electric Light, Heat & Power Company contemplates erecting surburban transmission lines in the spring, taking in two towns. T. P. Turner is general manager.

HOMESTEAD, PA.—Bids will be received until Feb. 3 by Andrew Hill, borough clerk, for lighting the streets of this borough for a period of one, three and five years.

NEWTOWN, PA.—The Bucks County Electric Railway Company is contemplating the entire reconstruction of its line and installing modern equipment. W. H. Janney is manager.

TITUSVILLE, PA.—The Titusville Electric Light & Power Company is contemplating rebuilding its entire plant next spring. Frederick Woodring is manager.

WASHINGTON, PA.—At a recent meeting of the East Washington Council a committee, consisting of Messrs. Bailey, Pollock and McIlvaine, was appointed to meet the officials of the Washington Electric Light Company, and endeavor to make terms on the granting of a franchise in the borough.

YORK, PA.—The York Railways Company has filed a $10,000,000 mortgage with the Guardian Trust & Safe Deposit Company, of Philadelphia, as trustee, to secure an issue of bonds to that amount for additional railways and other improvements. The mortgage covers properties of the Wrightsville & York, the York & Dover, York & Dallastown and Hanover & York Electric, and the York Haven and Red Lion and Windsor Railway companies, as well as those of the York Light, Heat & Power Company and York Suburban Land companies.

NEWPORT, R. I.—The Newport & Fall River Street Railway Company is changing the direct-current arc lamps in the street lighting system to the magnetite arc lamps. Robert S. Goff is manager.

BERESFORD, S. D.—Extensive additions and improvements are being made to the local electric light plant. The power house is being enlarged and a Murray-Corliss engine installed. Another generator will be added to the plant next summer. L. Wagner is owner and manager.

HUMBOLDT, TENN.—The Board of Public Works is contemplating establishing a day service in connection with the municipal electric light plant. W. A. Moore is superintendent.

MINERAL SPRINGS, TEX.—D. T. Bollar, president of the Fidelity Trust Company, of Fort Worth, and receiver for the Mineral Wells electric light and car system, on Dec. 18, ordered the entire plant to be closed down, including ice plant, electric light and all public utilities. The Fidelity Trust Company holds first mortgage on the plant, of which the St. Louis Car Company is a large creditor.

STOWE, VT.—The Mount Mansfield Electric Railway, which connects this village and Waterbury, a distance of 10 miles, was sold at auction on Dec. 20 for the American Trust Company, of Boston, Mass., the mortgagee. A. H. Soden, of Boston, Mass., president of the street railway company, purchased the road for $20,000. It is understood that Mr. Soden contemplates extending the railway from Stowe to Morrisville, a distance of eight miles.

FREDERICKSBURG, VA.—The Fredericksburg & Southern Railway Company will apply to the State Corporation Commission for a charter to construct and operate an electric railway from some point in Hanover County to Fredericksburg and northwestwardly, and also the operation of a street railway in the city of Fredericksburg, subject to the consent of the City Council. The officers of the company are W. C. Whitner, president; E. J. Smith, vice-president, and Alvin T. Embrey, secretary and treasurer.

PULASKI, VA.—John T. Loving, Mayor, writes that the municipal electric light plant is not adequate to meet the demands made upon it, and that the city is thinking of giving up the plant and granting a franchise to a private company. If this is done the equipment of the municipal plant will have to be greatly increased.

COLTON, WASH.—E. S. Aldrich, of Moscow, Idaho, manager of the Idaho-Washington Light & Power Company, writes that about $3,000 will be expended for work required in Colton. The company will do its own work.

SEDRO-WOOLEY, WASH.—Work will commence on the construction of the new electric railway between Sedro-Wooley and Anacortes, Jan. 1. B. J. Weeks is one of the chief promoters of the road.

TACOMA, WASH.—The Bismarck Mill Company, of Bismarck, will start work shortly on a steam power plant for the generation of electricity to supply the suburbs of Tacoma.

TACOMA, WASH.—Beal Foster and S. Lewis have been granted a franchise by the City Council to erect and maintain transmission lines for the transmission and distribution of electricity to customers outside of the city.

WHEELING, W. VA.—The Wheeling Electrical Company has notified the City Council of its intention to apply for an ordinance granting it a 50-year franchise.

ARKANSAW, WIS.—The capital stock of the Arkansaw Telephone Company has been increased from $2,400 to $5,000.

BERLIN, WIS.—O. C. Irwin, of Crawfordsville, Ind., has been in the city trying to interest capital in his electrical plant, which he wishes to remove from Crawfordsville, Ind., to this town.

BLAIR, WIS.—The capital stock of the Preston Farmers' Telephone Company has been increased from $5,250 to $12,250.

CHILTON, WIS.—Owing to the unsatisfactory service furnished by the Wisconsin Electric Light & Service Company, the City Council has refused to renew the contract for street lighting with the company, and the streets will not be lighted for some time to come. The Council may decide to use gasoline for lighting the streets.

MEDICINE HAT, ALB.—The Red Cliff Realty Company has recently installed an electric light plant. At present a 60-kw alternating-current generator is in operation. It is expected to enlarge the plant next summer and increase the equipment to 400 kw. C. W. Jewett, of Blackduck, Minn., has charge of the work.

OKOTOKS, ALB.—The by-law to purchase the local electric plant, as well as the by-law to erect a municipal plant, was defeated by the electors. This town is now without light, the local company having shut down because its plant was not a financial success.

VANCOUVER, B. C.—The British Columbia Electric Street Railroad Company is applying for a charter to build a railway from this city to Midway, a distance of about 210 miles. R. H. Sperling is general superintendent.

VANCOUVER, B. C.—A unit of 10,000 horse-power is being installed by the Vancouver Power Company at its plant at Lake Buntzen. It will cost, approximately, $300,000. The work will be completed within a month and immediately afterwards construction will be started on the installation of two more units of the same size.

ST. VITAL, MAN.—The Council is considering the advisability of building and operating an electric street railway from this town to Winnipeg, approximately 11 miles. Address J. P. Dumas.

WINNIPEG, MAN.—The Winnipeg Electric Company is now making arrangements for the building of a suburban electric street car line to St. Vital, a distance of approximately 11 miles. Wilford Phillips is general manager.

WINNIPEG, MAN.—At the election held Dec. 10 the by-law to issue $200,000 in bonds for the purpose of constructing an underground conduit for placing the telegraph, telephone and electric light and power wires underground was defeated.

TORBROOK, N. S.—The Londonderry Iron Mining Company has decided to install a $40,000 electric plant at its mines here.

YARMOUTH, N. S.—The Yarmouth Electric Company is being formed to take over the stock of the street railway company and extend the line. The company will also install a plant for lighting the city with electricity, in addition to supplying electricity for operating the railway system.

BRANTFORD, ONT.—The Brantford Electric Street Railroad Company, under the agreement recently ratified by the City Council, gets a 45-year franchise. Within the first two years the company must lay between 6 and 7 miles of track and during the last 25 years must pay the city $2,500 per annum.

COBALT, ONT.—The Council has granted a franchise to the Central Railway Company for an electric railway. It is expected that work will commence on the construction of the Cobalt-Liskeard section next spring, which will cost about $250,000.

HAMILTON, ONT.—The Cataract Power Company has renewed its offer made to the City Council early in the year to install pumps and equipment at the Beach pumping station. The company offers to pump the required amount of water for the city's use for a term of six years, putting in the requisite pumps and electrical equipment into a building to be furnished by the city at the Beach water works plant, and to operate the same for a term of six years for the same amount that it cost the city for the water pumped during the year of 1906. At the end of the six years the company agrees to turn over the whole of the equipment to the city, free of cost, and also agrees to enter into a contract to supply power, provided that it had it for sale, at the rate of one-half cent per hour per horse-power. W. C. Hawkins is secretary and general manager of the Cataract Power Company.

INGERSOLL, ONT.—The City Council has decided to submit the proposition to the people to issue $50,000 in bonds for the purpose of acquiring the plant of the Ingersoll Electric Light & Power Company to be operated as a municipal electric light plant.

LONDON, ONT.—The city engineer has been instructed by the Board of Works to prepare plans for a new belt line to be operated by electricity in the north part of the city.

LONDON, ONT.—At the coming civic elections the ratepayers will vote on a by-law to provide $235,000 for a power distributing plant in connection with the Niagara Falls plant.

OTTAWA, ONT.—The Civic Electric Commissioners and the Ottawa Electric Light Company have come to terms, the city taking over the company's plant on Dec. 20 for $29,000. The commissioners offered $24,000 and the company asked $31,000.

WELLANDPORT, ONT.—We have been informed that the Dunnville, Wellandport & Beamsville Electric Railway Company will begin work on the construction of its road next spring. The road is to extend from Dunnville to Wellandport, St. Anns and Beamsville. The section from Dunnville to St. Anns, a distance of 15 miles, will be built next summer. James A. Ross is president of the company.

QUEBEC, QUE.—The Quebec Railway & Light Company will apply to the Dominion Government for permission to increase its capital stock.

QU'APPELLE, SASK.—The civic electric light plant here, which has been under construction for some months past, will be completed shortly. It will provide lights for the streets as well as residences and factories. Address C. F. Cates.

New Incorporations.

FORT SMITH, ARK.—The Nelson Investment Company was recently incorporated for the purpose of building, owning and operating electric street railway systems, water works, etc. The company is capitalized at $100,000, and the officers are: J. T. Nelson, president; J. M. Spaulding, vice-president; T. A. Trusty, secretary, and J. T. Wright, treasurer.

OAKLAND, CAL.—Articles of incorporation have been filed for the Oakland Transcontinental Aerial Telephone & Power Company, with a capital stock of $200,000, by Albert G. Rodkel and others.

BOISE, IDAHO.—Incorporation papers have been prepared for the Idaho & Nevada Southern Railway Company. The company proposes to build an electric railway to connect Jerome and Wells, a distance of 127 miles. The capital stock of the company is placed at $500,000. The officers of the company are H. L. Hollister, president; I. B. Perrine, vice-president, and R. M. McCollum, secretary and treasurer.

CHICAGO, ILL.—Articles of incorporation have been filed for the Central Illinois Railway Company by Josiah Burnham, Hugo De Loeb, George L. Turnbull and L. H. Strickler. The company is capitalized at $2,500, and proposes to construct and operate a railway from Chicago to Lyons, in Cook County, and to other points in the counties of Cook, Du Page, Will, Bureau, Peoria, Kendall, Grundy, La Salle, Livingston, Putnam, Marshall, McLean and Woodford.

ELDORA, IA.—Articles of incorporation have been filed for the Providence Township Mutual Telephone Company, with a capital stock of $10,000, by W. G. Mitchell and others.

KALAMAZOO, MICH.—Articles of incorporation have been filed with the Secretary of State for the Kalamazoo Power Company, by Frank W. Armstrong, C. S. Smedley, and H. H. Freeland, all of Grand Rapids, Mich. The company is capitalized at $50,000 and proposes to build a large power plant to furnish power and steam heating in the city of Kalamazoo, under the franchise recently granted to Mr. Armstrong by the City Council. Plans for the electrical plant are now being prepared by W. D. Ball, of Chicago, Ill. The present plan contemplates installing a plant of 10,000 horse-power to be operated by gas engines. According to its franchise the company is limited to a charge of eight cents per kw-hour for electric service.

KENSINGTON, MINN.—The Kensington Telephone Company has been incorporated with a capital stock of $10,000, by A. H. Christenson and others.

BELLEVILLE, MO.—The Red Bud & Belleville Interurban Railroad Company has filed articles of incorporation for the purpose of constructing and operating an electric railway from Belleville to Smithton, and thence to Red Bud, Ill. The incorporators are: Conrad Becker, Herman Schreiber and Dr. C. G. Smith, of Red Bud, Ill.; John Keller, of Hecker, Ill., and Benjamin A. Gundlach, of Belleville.

CARSON CITY, NEV.—The Northwest Light & Power Company has been incorporated with a capital stock of $1,000,000.

NEW YORK, N. Y.—The Casey-Electric Company has been incorporated with a capital stock of $10,000. The directors are Fred Knowlton and W. E. Allen.

NEW YORK, N. Y.—The Dunn Light Company has filed articles of incorporation with the Secretary of State with a capital stock of $25,000. The directors are Warren H. Dunn, Darlington, N. J.; Edwin S. Dunn, and Lawrence C. Shepherd, of New York.

SPRINGWATER, N. Y.—The Canadice Telephone Company has been incorporated with a capital stock of $7,200 by L. M. Doolittle and others.

NEW LONDON, N. C.—The New London Development Company has been incorporated with a capital stock of $10,000, by F. A. Silver, of Greensboro, and others. The company proposes to do a real estate business and to construct, purchase and operate electric light and power plants, etc.

SAWYER, N. D.—The Western Telephone Company has been incorporated with a capital stock of $50,000, by William Hodges and others.

BERGHOLTZ, OHIO.—The Bergholtz Electric Light & Power Company has been incorporated with a capital stock of $10,000, by E. Steimetz, James B. Marshall and others.

CINCINNATI, OHIO.—The Ohio Public Service Company has been incorporated with a capital stock of $10,000, by E. B. Smole, L. A. Ford, George H. Swift, G. P. Hunt and C. C. Werner, who are said to represent Eastern men. The company has a twenty-five year franchise for street lighting at Bradford, Ohio, where a contract has already been entered into. It is the intention to build lighting and water plants at various points in the state.

HAWKINS, WIS.—Articles of incorporation have been filed for the Hawkins Telephone Company, with a capital stock of $800 by Anton Paulson, A. C. Thompson, W. H. Pearce and others.

MORRIS, WIS.—Articles of incorporation have been filed for the Morris Telephone Company with a capital stock of $1,200 by Charles H. Holun, Peter Frederickson and Thomas Larson.

MANITOWOC, WIS.—The Farmers' Telephone Company has been organized to construct a telephone line from Sheboygan to Centerville.

Legal.

EIGHTY CENT GAS ILLEGAL.—Judge Hough, of the United States District Court, New York City, has handed down an exhaustive opinion on the eighty-cent gas case. He favored the report of the referee, Arthur H. Masten, but ordered slight modifications. Mr. Masten's opinion was in favor of the Consolidated Gas Company and against the Eighty-cent law, which was declared by the referee to be confiscatory. The court holds that the first prayer of the bill, relating to the constitutionality of the law, must be granted, upon the ground that both the statutes involved, as well as the order of the Commission of Gas and Electricity, were in contravention to the Fourteenth Amendment of the United States Constitution. The effect of this was that Judge Hough affirmed Mr. Masten's opinion that the Eight-cent gas law was not constitutional. It was ordered by the Gas and Electricity Commission that the Consolidated Gas Company and subsidiary corporations should supply gas to New York City at eighty cents a thousand feet. This, according to Judge Hough, was unconstitutional, at is was practically a confiscatory order. Taking up the question of monopoly, the court states: "The monopoly is beneficial. To have the streets of Manhattan torn up to afford room for the mains of a rival is unthinkable." Speaking of the capitalization of franchises or the contention of the company that it has a right to expect a fair return upon "not only its tangible property, but the right to use that property in the gas business," the court disagrees, and says that return can only be expected from investment. Judge Hough says that in his opinion the best measure of valuing franchises is the stock issued against them by the incorporators, and places their value at $12,000,000, thus placing the total valuation of the company's business at $59,000,000 and the earnings much less than 6 per cent. Of the gas law, Judge Hough says that when under the guise of legislation rates are not fixed by action of a commission or subordinate, but by direct legislation, "representative government as prescribed by both Federal and State Constitutions is at an end."

RIGHT OF ELECTRIC COMPANY HOLDING EXCLUSIVE FRANCHISE TO RESTRAIN NEW COMPANY FROM EXERCISING SIMILAR RIGHTS.—The laws of the State of Pennsylvania empower boroughs to "light the streets" and, this authority having been construed by the courts to include the power to contract for lighting the streets by electricity, the borough of Muncy granted to the Muncy Electric Light, Heat & Power Company, which was organized for the purpose of furnishing light to the borough, the exclusive right to erect poles and extend wires on the highways of the borough for a period of ten years. Three years later the borough passed an ordinance granting to the People's Light, Heat & Power Company the right to place its poles and string its wires along the highways of the borough for the purpose of supplying electric light and power to the borough and its inhabitants, and, pursuant to this statute, the latter company commenced the construction of its lines. The Borough Company thereupon sought an injunction restraining the People's Company from going ahead with the work of erecting its poles and wires on the ground that it constituted a breach of its (the Borough Company's) contract with the borough of Muncy and an interference with its franchise. It was objected by the People's Company that the borough had no power to grant an exclusive franchise without express legislative sanction. It was held, however, that the borough did have such a right and that the Borough Company was entitled to an injunction restraining the People's Company from interfering in any way with its franchise. Neither company had any rights in the streets of the borough without the borough's consent. The borough, under the statutes, might have built its own light plant and refused all franchises to others, or it might have granted a franchise on its own terms and conditions. And what the borough might have done by itself it might do by contract with others. That is what it did in this instance. Instead of expending the public money in building a plant, it accepted the offer of the Muncy Company to build the plant in consideration of a franchise which was to be exclusive for ten years. It was a valid exercise of the borough's contractual power, on a valid consideration, and could not be rescinded directly or indirectly at the will of one party. Muncy Electric Light, Heat & Power Company vs. People's Electric Light, Heat & Power Company, Supreme Court of Pennsylvania, 67 Atl. Rep. 956.

JUDGMENT FOR DAMAGES AGAINST POWER COMPANY REVERSED.—The plaintiff, at the time of the accident which resulted in his injuries, was engaged in painting the roof of a factory building. As he was in the act of lifting a ladder used in his work, the end of which projected slightly over the edge of the roof, his hand came in contact with a neutral wire about eleven inches from the edge of the roof, and two feet distant from a 2300-volt wire. According to the plaintiff's testimony, he thereupon received a shock which rendered him unconscious and caused him to fall across the two wires, where he was found by his fellow workmen. The company claimed that the accident could not have been caused by touching the neutral wire, and a number of witnesses testified that they had taken hold of this wire, while the neighboring wire was carrying its regular high-voltage alternating current, and had received no shock whatever. The case was submitted to the jury with instructions that they were at liberty to refer the plaintiff's injuries to contact with either wire and to charge the company with negligence in maintaining either or both wires. Against this manner of submitting the case the company's evidence as to the harmlessness of the neutral wire was of little avail, and the jury returned a verdict in favor of the plaintiff and assessed his damages at $10,000. With reference to the actual state of evidence, it could not be definitely determined upon what ground the jury found the company liable, nor what weight was given to the evidence introduced in its behalf. Some of the jury may have attributed his injuries to contact with one wire, some to contact with another, and some may have been convinced that it was not negligence to string the wire 35 inches from the building; others that the negligence consisted in the location of the neutral wire; still others in the lack of insulating covering on one or both. In short, it was impossible to tell for what the defendant was held liable, when under the evidence it could only be held liable, if at all, for negligence in placing the neutral wire, or the wire nearest the building, that being the wire with which the plaintiff came in contact. For these reasons the verdict was reversed and a new trial ordered. Rasmussen vs. Wisconsin Traction, Light, Heat & Power Company, Supreme Court of Wisconsin, 113 N. W. Rep. 453.

EXCEEDING INSTRUCTIONS HELD NOT TO BE NEGLIGENCE ON PART OF LINEMAN SO AS TO PRECLUDE RECOVERY OF DAMAGES.—The plaintiff, in company with another lineman and a foreman, all three of whom were employed by the defendant electric

company, were sent out by the company to remove a transformer from one pole and place it in position on another. The plaintiff had been informed that there was necessity for haste in order to get the transformer in place in time to furnish electricity for the lamps at a public function soon to be held. The transformer was taken down without mishap and carried to the pole to which it was to be attached. The plaintiff ascended the pole and affixed the cross-arm on which the transformer was to be placed. The next act in the process was to attach a pulley at some point on the pole far enough above the cross-arm to allow the hoisting of the transformer to the cross-arm by means of a rope through the pulley. To attach the pulley at the proper place, it was necessary to climb to the top of the pole, where electric wires belonging to the company were strung. The plaintiff saw the other men on the ground getting ready to throw him the rope necessary in hoisting the block and tackle to be used in raising the transformer, and he also saw the foreman take the cord containing the transformer to run it up under the pole. He accordingly, and without waiting for specific instructions, ascended to the top of the pole to attach the pulley to hoist the transformer and there came in contact with the wires of the company, which, without his knowledge, were at high voltage, which caused the injury for which the action was brought. One of the claims of the defense was that the instructions given to the plaintiff by the company, acting through the foreman, went no further than to require the plaintiff to attach the cross-arm, and that in going to the top of the pole the plaintiff voluntarily exposed himself to danger, for which voluntary exposure the company could not be held liable. In affirming a verdict of $30,000 in favor of the plaintiff, the court said in part: "If he had been slow to perceive these preparations, and dilatory in his part of the work, awaiting a specific direction for each act in the process, he would have been justly chargeable with inefficiency and neglect of duty. It would be strange doctrine to hold that the promptness of a servant in going forward to perform the well-known parts of a task he is set to do would relieve the master from his duty to furnish a safe place and warn the servant of the dangers of the situation to which his duty calls him. The master expects and is entitled to the exercise by the servant of reasonable zeal to see and do what is to be done by him in the course of the work in which he is engaged. Expecting this, he must anticipate it in the performance of his own duty to the servant, and his warning and protection must extend to all dangers which the servant will usually incur in the exercise of such reasonable zeal and diligence as are not known to the servant or obvious to ordinary observation, and which arise from causes controlled by the master. The plaintiff's diligence did not go beyond this ordinary and reasonable diligence to which he was bound. Under all the circumstances of the case the master cannot be allowed to excuse himself on the ground that specific directions to attach the pulley were not given." Reeve vs. Colusa Gas & Electric Company, Supreme Court of California, 92 Pac. Rep. 89.

Educational.

THE PENNSYLVANIA STATE COLLEGE.—Dr. Edwin Erle Sparks, at present professor of history in the University of Chicago, has been elected president of the college, and will assume his duties next June. Two important changes have been arranged for in the school of engineering. Professor J. P. Jackson, of the department of electrical engineering, has been appointed dean of the school, to succeed Professor L. E. Reber, of the mechanical engineering department, who has resigned to accept a position at the University of Wisconsin. Professor Hugo Diemer, formerly of the University of Kansas, has been appointed head of the department of mechanical engineering.

LECTURES AT SEATTLE.—Thirteen practical lectures in electrical engineering, by prominent electrical engineers of the Pacific Northwest, have been planned by the electrical engineering department at the University of Washington for the students in the engineering courses and for practical electricians of Seattle and nearby places. The lectures began Dec. 11, and will be held at 8 p. m. in Room 3 of science hall at the university. The first five lectures will be on "Telephones," by C. E. Fleager, superintendent of construction of the Pacific Telephone Company for Washington, Oregon and Idaho. The next five will be on "Central Station Practice," by James D. Ross, superintendent of the Seattle municipal light and power system. The last three will be given by John Hariberger, general superintendent of the Seattle-Tacoma Power Company, on the subject of "Electric Power Transmission."

Obituary.

MR. J. W. PERRY.—A special telegram from Newberry, S. C., of Dec. 13 says: "J. W. Perry, manager of the Bell Telephone Company in this city, died at his home to-day from blood poisoning. The malady was the result of a slight injury sustained several weeks ago, when he stuck a small piece of copper wire in his finger. Little attention was paid to the wound until a week ago, when blood poisoning set in. From that time until his death he suffered great pain. Mr. Perry came to Newberry a year ago from Summerville to accept a position as manager of the Bell Telephone Company. During his residence here he made many friends. Mr. Perry is survived by his wife and several small children. The remains will be taken to Charleston for interment."

Personal.

Prof. J. P. Jackson.

PROFESSOR JOHN PRICE JACKSON, whose appointment as dean of the school of engineering at the Pennsylvania State College is noted elsewhere in this issue, graduated from the course in mechanic arts and later from the mechanical engineering course of the above named college, receiving the degree of B. S. in Mechanical Engineering in 1889. He subsequently received the degrees of M. E. and E. E. from the same college. In his early career he was connected with the Edison Illuminating Company, of Philadelphia, and the Sprague and Edison companies of New York City. He also obtained considerable experience while with the Western Engineering Company, of Lincoln, Nebraska. He was appointed Professor of Electrical Engineering at the Pennsylvania State College in 1894. At the present date the department of electrical engineering has an enrollment of more than 700 students. The school of engineering, of which Professor Jackson now serves as dean, offers courses, with options, in electrical, civil, mechanical, sanitary, hydraulic and electrochemical engineering. Professor Jackson is a member of the American Society of Mechancial Engineers, the American Institute of Electrical Engineers, the American Society for the Advancement of Engineering Education, the Harrisburg Engineers' Club and other technical organizations. He is a joint author of "Alternating Currents and Alternating Current Machinery" and "Electricity and Magnetism," two standard text-books in electrical engineering, and has written numerous articles on educational and engineering topics which have appeared in society transactions and other technical publications. Professor Jackson has acted as consulting engineer for various companies and towns. Among other work, he made a thorough test of the luminous arc lamp upon its appearance upon the market, and upon his recommendation it was adopted by the city of Harrisburg as a standard for city illumination. This installation, which was the first large equipment of the kind in this country, has given excellent service.

MR. A. L. KENYON, chief engineer of the Santa Rosa transmission plant in Peru and the Lima-Callao electric railway, arrived last week in New York on a short vacation.

MR. R. JEMISON.—Mr. Robert Jemison has retired from the presidency of the Birmingham (Ala.) Railway, Light & Power Company, and the board of directors has passed some very eulogistic and enthusiastic resolutions on his work for 20 years.

MR. W. S. DIX has recently severed his connection with Messrs. Sanderson & Porter, with whom he has been connected for seven years, and has entered upon the duties of sales engineer for the R. Thomas & Sons Company, with headquarters in New York City.

MR. R. O. JONES has been appointed chief engineer of the Dayton Hydraulic Machinery Company. Mr. Jones has had a wide experience in the manufacture and construction of pumps of all kinds, having been for the past nine years associated with the Jeanesville Iron Works, of Hazleton, Pa., and for several years past was their chief engineer.

CAPTAIN GODFREY L. CARDEN, U. S. R. M., will shortly go abroad on a commission from the U. S. Government to make a study of manufacturing conditions in Europe so far as they have a bearing on export trade. Captain Carden about four years ago made an extended tour of European manufacturing centers in the interest of the St. Louis Fair, and succeeded in having taken up all of the space assigned to European manufacturers.

MR. JOHN A. ROEBLING, son of Colonel Washington Roebling, of Brooklyn Bridge fame, owner of Beauxchenes, a $500,000 country estate on the St. Dunstan Road, between Asheville and Biltmore, North Carolina, has deeded over the entire property to the Home Mission Board of the Northern Presbyterian Church, and will return soon to his home in Trenton, N. J. Mr. Roebling says he is leaving Asheville because the city has gone for prohibition, of which he does not approve on principle.

MR. T. F. BECHTEL.—Mr. Thomas F. Bechtel, general auditor for the Grand Rapids-Muskegon Power Company since the amalgamation of that enterprise with the Grand Rapids Edison Company last summer, has resigned his position. This will take immediate effect, although Mr. Bechtel will remain with the company a reasonable period to admit of the appointment of a successor. He has made no definite business plans for the future and will make none until after his return from a trip to Florida and Cuba in search of rest and recreation. His relations with the company and with his associates have been pleasant and he leaves its service with the best of wishes for its growth. Mr. Bechtel has been connected with the electric light and power company since the organization of the Grand Rapids Edison Company, about twenty years ago. It was to his energy and personal efforts as secretary and treasurer, offices he filled for many years, that its extensive growth and successful business was largely due.

Trade Publications.

PORTABLE STORAGE BATTERIES.—The Westinghouse Machine Company, East Pittsburg, Pa., has issued Catalogue P, dealing with storage batteries for portable service.

PORTABLE INSTRUMENTS.—Bulletin No. 4554 of the General Electric Company has for its subject Type P3 voltmeters, wattmeters and ammeters, which are described and their details illustrated. Mechanically the instruments are strong and light, and of small size, so that several instruments may be carried with ease. They have a light-weight moving element not susceptible to damage in transportation, and one of the strongest recommendations of their reliability when used for laboratory or general testing purposes is their ability to give accurate indications when used in the vicinity of external magnetic fields. The voltmeters and wattmeters are constructed on the direct-reading dynameter principle, the ammeters on the well-known Thomson inclined coil principle. The pointer fluctuations are dampened by means of Foucault currents set up in a thin aluminum segment attached to the shaft. Pivots are made from the best grade of steel specially hardened and highly polished, and are suspended in high-grade sapphire jewels. Catalogue numbers, capacities and list prices are given in the bulletin, and full-sized sample scales of the various instruments are reproduced.

Business Notes.

THE NORTHERN ENGINEERING WORKS, crane builders, Detroit, Mich., have installed in the power station of the St. Clair Tunnel Company, Port Huron, Mich., a fifteen-ton, 43-ft. span, traveling crane.

GOLD MEDALS FOR ALLIS-CHALMERS COMPANY.—A gold medal has been awarded to the Allis-Chalmers Company for electric generators and motors by the authorities of the Jamestown Exposition, upon the recommendation of the jury consisting of well-known technical experts representing leading electrical interests of the country. A second gold medal was also granted for the good judgment and taste shown in the design and erection of the exhibit, which has been one of the most attractive features of "Machinery Hall."

BELTED CORLISS.—The Allis-Chalmers Company, of Milwaukee, Wis., has just issued bulletin No. 1501, devoted to its belted Reliance Corliss engines. The popularity which these engines have attained is due to their reliability, durability and simplicity of construction. The Reliance pattern of the Reynolds-Corliss engine was designed to meet the demand for a strong and serviceable machine which would occupy less floor space and run at somewhat higher speeds than is usual in Corliss engine practice, thus, in many cases, better adapting it to be used as a prime mover for electric generators and other fast running machinery.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DEC. 17, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

873,702. ALTERNATING-CURRENT MOTOR; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed Feb. 15, 1904. In a combination, a dynamo-electric machine having a distributed winding on each member, the conductors of each winding being permanently connected in groups, an external circuit connected to each winding, and means for varying the numbers of poles of both members.

873,703. ELECTRICALLY PROPELLED CAR OR LOCOMOTIVE; Edward H. Anderson, Schenectady, N. Y. App. filed April 5, 1906. Electric railway system in which the current is supplied to the locomotive as high voltage alternating current, during normal running, and as low voltage direct current while within the city limits. Relates to controller circuits.

873,705. INSULATING COVERING OR SHEATHING FOR CONTACT RAIL CONDUCTORS; William H. Baker, Lockport, N. Y. App. filed Oct. 19, 1905. A form of insulating sheath adapted to embrace the rail and having a locking piece or key serving to keep the sheath in place on the rail.

873,706. MOTOR TRUCK; Asa F. Batchelder, Schenectady, N. Y. App. filed May 28, 1906. Provides a motor truck in which the electrical and mechanical features are designed to co-operate to produce a truck which is simple, durable and of maximum electrical capacity. Includes manner of suspending motor frames.

873,714. DYNAMO ELECTRIC MACHINE; Joseph L. Burnham, Schenectady, N. Y. App. filed April 1, 1907. The field pole is divided into two sections, one larger than the other. The main winding is placed on the large pole and a regulating winding on the small pole.

873,715. ELECTRICAL ACCUMULATOR; Charles Busch, New York, N. Y. App. filed June 25, 1907. A form of electrode for storage batteries having a lead box or casing inclosing active material.

873,720. SWITCH STAND; Arthur D. Cloud, Chicago, Ill. App. filed Sept. 27, 1906. Has means for locking open an automatically closing switch and a magnet switch having opening and closing devices for releasing said locking means and controlled by the passage of a train on a side track or upon the main track.

873,721. TRANSFORMER; Jesse Coates, Lynn, Mass. App. filed Feb. 12, 1906. Form of arrangement of laminæ for a transformer core.

873,729. THROTTLE RELAY; Archibald S. Cubitt, Schenectady, N. Y. App. filed March 31, 1906. Relates to current relays adapted to govern circuit controlling devices in order to prevent the circuit conditions from becoming abnormal.

873,732. BATTERY TRAIN LIGHTING SYSTEM; Frank A. Decker, Philadelphia, Pa. App. filed April 4, 1906. Patentee has a battery box beneath the car body and compressed air pipes for transferring the solution from one tank to another.

873,737. AUTOMATIC CUT-OUT FOR ELECTRIC CONTROLLERS; Arthur C. Eastwood, Cleveland, Ohio. App. filed Jan. 15, 1907. Relates to means for automatically cutting off the supply of energy to an electric motor and stopping it in such a manner that the operator may again start the motor in either direction by the operation of a master controller without manipulation of additional switches.

873,741. SWITCH OPERATING MECHANISM; Edwin E. Frederick, Bellevue, Pa. App. filed April 12, 1906. Provides means by which the successive movements of a device in the same direction will cause alternate movements of a switch. Has a step by step ratchet device.

873,751. CONDENSER; Nelson S. Hopkins, Fort Wayne, Ind. App. filed Nov. 15, 1902. Patentee has layers of a condenser lapped in such a way that the thickness of the dielectric at the edges is greater than at the center.

873,757. TRANSMITTING DEVICE FOR ELECTRIC TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed March 16, 1905. An arrangement for transmitting signals of opposite polarity to a cable line by manipulation of an ordinary Morse key.

873,778. DYNAMO-ELECTRIC MACHINE; Karl A. Pauly, Schenectady, N. Y. App. filed May 18, 1907. In combination, an electric generator, an electric motor supplied thereby, a separate source of current for the generator field windings, means for varying the field current of said generator, and means for adjusting the magnetic time-lag of the generator field.

873,780. INSULATED COIL; Charles F. Peterson, Schenectady, N. Y. App. filed June 22, 1907. A process of forming a coil which will be a self-contained unit without any wrapping or supporting means, and which is furthermore absolutely refractory.

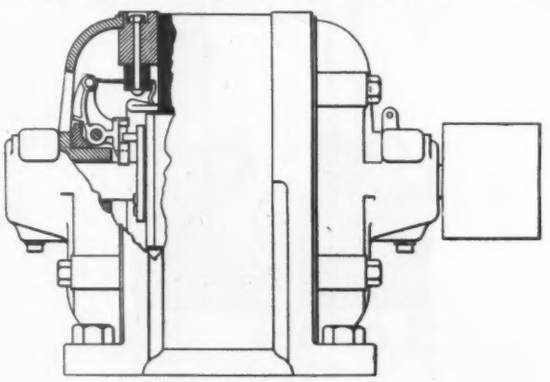
873,781. CABLE DRUM MECHANISM; Claiborne Pirtle, Cleveland, Ohio. App. filed March 6, 1907. A tension device for cables comprising a drum and an electric motor having its rotatable member connected in driven relation to the drum, and a resistance permanently in circuit with said motor.

873,793. SAFETY FUSE INDICATOR; Caroline N. Sachs, Hartford, Conn. App. filed March 11, 1904. An indicating device for a safety fuse comprising a resilient indicator and means broken by the fusion for releasing such resilient indicator.

873,804. ELECTRIC LIGHTING; Elmer A. Sperry, Brooklyn, N. Y. App. filed Dec. 13, 1906. Has means for agitating incandescent lamps in use so that they will be self-welding in case the filaments are broken.

873,805. CONTROLLER; Emmett W. Stull, Norwood, Ohio. App. filed March 31, 1906. A means for preventing the destructive arcing which occurs between the fingers of a controller.

873,815. SWITCHING DEVICE FOR ELECTRIC MOTORS; John B. Wiard, Lynn, Mass. App. filed May 23, 1907. Relates to an automatic switching device for electric motors arranged to change the connections of the motor from starting to running conditions. Has a centrifugal device on the motor shaft.



873,815.—Switching Device for Electric Motors.

873,839. AUTOMATIC SIGNALING DEVICE; Louis Caputo, East Boston, Mass. App. filed Aug. 23, 1907. Has special conductors between the track rails engaged by trolley wheels depending from the train.

873,846. CARTRIDGE FUSE ATTACHMENT PLUG; Robert A. Culta, Cambridge, Mass. App. filed July 3, 1907. A cartridge fuse attachment plug which cannot be destroyed by the burning of the fuse.

873,861. ELECTRIC FURNACE; Gustaf Holmgren, Westeras, Sweden. App. filed March 6, 1907. An electric induction furnace having a stationary iron core and melting chamber inclosing said core. A rotary magnet is effective to alternately magnetize the iron core so as to generate a current in the molten material of the furnace.

873,872. HOUSING; Hubert Krantz, Brooklyn, N. Y. App. filed Jan. 26, 1907. A small bracket or fixture adapted to be placed on a thumb-screw so as to cover up the circuit wire connection.

873,891. PROCESS FOR THE PRODUCTION OF NITRIC ACID OR NITRIC OXID FROM ATMOSPHERIC AIR; Henry Paulding, Gelsenkirchen, Germany. App. filed April 6, 1906. The herein described process, consisting in heating air to a temperature of about 1200 degrees C. and then immediately blowing into the air thus heated a cooled off portion of air previously heated to the said temperature and then immediately cooled down.

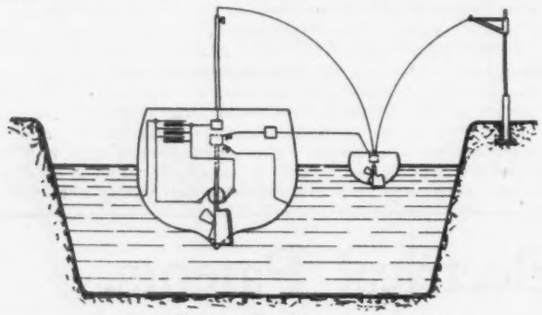
873,890. ELECTRIC SMELTING FURNACE; William R. Parks, Chicago, Ill. App. filed April 11, 1907. An electric furnace having a negative electrode with a circular gutter in its upper surface and having drains leading therefrom.

873,899. CURRENT SUPPLYING ARRANGEMENT; Bernhard Salomon, Frankfort-on-the-Main, Germany. App. filed March 1, 1906. Has a stationary electric conductor and means including an independently propelled device for conducting current from the conductor to the canal boat.

873,935. ELECTRICAL ALARM SYSTEM; William N. Fawcett, Brooklyn, N. Y. App. filed Jan. 15, 1907. Patentee has barred windows, the bars being specially constructed to close alarm circuits in case they are destroyed.

873,940. ELECTRICAL CONNECTION FOR HOSE COUPLINGS; Frederick Hoffman, Cincinnati, Ohio. App. filed June 30, 1906. A telescoping connection for hose-couplings adapted to complete a telephone circuit.

873,943. PROCESS OF TREATING ORES; Frederick M. Johnson, San Francisco, Cal. App. filed June 3, 1904. Consists in mixing the



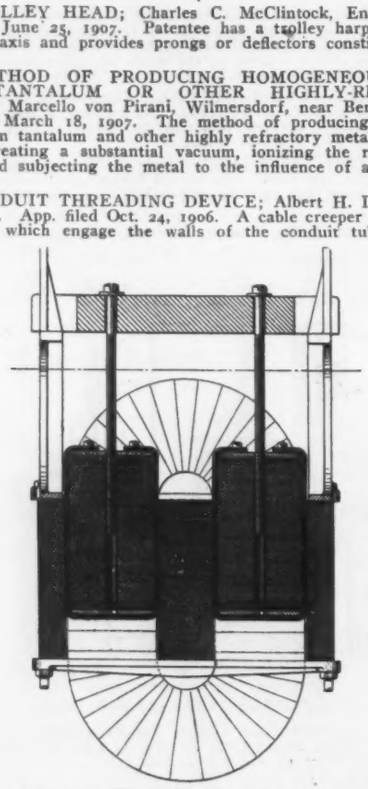
873,899.—Current Supplying Arrangement.

solution in a cyaniding tank with a soda solution which dissolves silver.

873,955. TROLLEY HEAD; Charles C. McClintock, Englewood, Col. App. filed June 25, 1907. Patentee has a trolley harp swivelled on a vertical axis and provides prongs or deflectors constituting a wire guard.

873,958. METHOD OF PRODUCING HOMOGENEOUS BODIES FROM TANTALUM OR OTHER HIGHLY-REFRACTORY METALS; Marcello von Pirani, Wilmersdorf, near Berlin, Germany. App. filed March 18, 1907. The method of producing homogeneous bodies from tantalum and other highly refractory metals, which consists in creating a substantial vacuum, ionizing the residue of gas therein and subjecting the metal to the influence of an electric arc therein.

873,996. CONDUIT THREADING DEVICE; Albert H. De Voe, Elizabeth, N. J. App. filed Oct. 24, 1906. A cable creeper having wheels or rollers which engage the walls of the conduit tube and which



874,042.—Block Signaling Apparatus.

are propelled by a ratchet device to move the creeper along under the impulse of successive pulls on the operating cord.

874,004. TELEPHONE-TRANSMITTER; Howell W. Haff, Richmond Hill, N. Y. App. filed April 16, 1907. Covers an extremely sensitive form of transmitter having means for directing the sound against both the front and the rear wall of the instrument so as to get double efficiency.

874,016. TURN BUTTON FOR ELECTRIC SWITCHES; Henry E. Leppert, New Britain, Conn. App. filed Oct. 29, 1904. Relates to turn buttons for electric switches and has special means for attaching the button to its spindle with adequate security.

874,019. END CAP FOR ELECTRIC CONDUITS; Harry P. Moore, Newburyport, Mass. App. filed April 6, 1907. A stamped sheet metal part adapted to fit over the end of a conduit pipe so as to cover the usual burr which is liable to abrase the wire.

874,023. NON-INDUCTIVE RESISTANCE; James F. McElroy, Albany, N. Y. App. filed Feb. 21, 1907. Construction of electrical resistance unit, including a resistance wire wound in alternate longitudinal and transverse layers within an inclosing tube

874,024. ELECTRIC BELL; James F. McElroy, Albany, N. Y. App. filed Feb. 21, 1907. Relates to electro-magnetic trembler bells having an improved compact structure in which the electrical conductors are insulated from the frame of the bell. Used for high-voltage circuits of trolley cars, etc.

874,025. SYSTEM OF MOTOR CONTROL; Alexander McIver, Schenectady, N. Y. App. filed March 8, 1905. Systems of control for motor circuits having contactors closed in an automatic progression. Relates to mechanical features and electrical circuits.

874,029. ELECTRIC HAT CURLING IRON; Joseph L. O'Brien, South Norwalk, Conn. App. filed July 1, 1907. A flatiron of specially curved form for curling hats. It has longitudinal channels in which the resistance elements are received.

874,040. METHOD FOR DETINNING AND PRODUCING TIN COMPOUNDS AND OTHER PRODUCTS; Elmer A. Sperry, New York, N. Y. App. filed Nov. 29, 1905. The process of detinning, which consists in reacting on the masses to be detinned with chlorine in the presence of stannic chlorid hydrate.

874,042. BLOCK SIGNALING APPARATUS; John D. Taylor, Edgewood Park, Pa. App. filed Aug. 24, 1907. Block signaling apparatus having a transformer specially designed for supplying alternating current to the track circuit of the system in a quantity to suit the requirements thereof.

874,064. ELECTROLYTIC CELL; Arthur E. Gibbs, Wyandotte, Mich. App. filed June 2, 1906. Electrolytic apparatus having a diaphragm and a cathode having projections embedded in said diaphragm.

874,085. RAIL BOND FOR RAIL JOINT CIRCUITS; William E. Karns, Parker's Landing, Pa. App. filed Jan. 29, 1907. In place of a rail bond wire of the usual form, patentee has spring plates fitting between the abutting ends of the rail.

874,118. TELEPHONE-TRANSMITTER; Carl J. Printz, Milwaukee, Wis. App. filed Dec. 31, 1906. A telephone transmitter, comprising a mouthpiece, a member with which the mouthpiece is connected, and an annular disinfectant receptacle having a contracted inner edge fitting between the mouthpiece and the said member and communicating with the interior of the mouthpiece.

874,147. THREE-WIRE MULTIPLE SYSTEM; Charles S. Winston, Chicago, Ill. App. filed March 12, 1906. Common battery telephone system having two wires extending throughout the multiple of the switchboard section of the lines for talking purposes, and a third wire provided for testing and signaling purposes.

874,163. ARMATURE WINDING MACHINE; Penrose E. Chapman, St. Louis, Mo. App. filed Aug. 15, 1904. The armature is supported transversely across the face of a chuck which has wire guiding fixtures applied thereto.

874,173. CONTROLLER REGULATOR; Cyrus P. Ebersole, Keokuk, Ia. App. filed April 15, 1907. Regulator for electric controllers adapted to prevent the hood from being removed from the base, although not preventing the movement of the hood.

874,178. CAUTERY; Lee De Forest, New York, N. Y. App. filed March 1, 1907. A system for cauterizing by high-frequency currents. Has an electrode consisting of a conducting member terminating in a cutting edge.

874,186. MAGNETIC BRAKE; Frederick G. Haldy, Stamford, Conn. App. filed June 17, 1907. A magnetic clutch having a pair of discs with intermediate bar electro-magnets having their opposite poles presented to their respective discs.

874,190. AUTOMATIC CIRCUIT BREAKER; Gerald W. Hart, West Hartford, Conn. App. filed Jan. 25, 1907. An electric switch in a door latch or lock whereby the lamps of a room will be extinguished when the tenant or guest leaves the room.

874,208. POLE CHANGER; Lee Kiblinger, Jackson, La. App. filed July 8, 1907. Pole changer in which momentum of a vibrating hammer is employed in such a way as to increase the abruptness in the make and break.

874,209. ELECTRIC TRANSMISSION OF INTELLIGENCE; Isidor Kitsee, Philadelphia, Pa. App. filed Aug. 26, 1907. Means to neutralize the inducing effect of a power wire on neighboring lines of transmission and comprising a conductor placed in the neighborhood of the lines of transmission and connected in shunt with the return of said power wire.

874,219. BRAKE FOR POWER DRIVEN VEHICLES; Joseph N. Mahoney, Brooklyn, N. Y. App. filed Oct. 30, 1905. Electrical vehicle brake having a spring normally under tension by reason of a gear connection from an operating motor. Has hand-controlled devices by which the spring is released to apply the brake.

874,227. PORTABLE BURGLAR ALARM; Joseph L. Mulry, Pawtucket, R. I. App. filed Aug. 14, 1907. Burglar alarm having a small circuit-closing fixture attached to the window frame and quickly removable when desired.

874,229. CONTROLLING MECHANISM; John J. Nef, Chicago, Ill. App. filed Sept. 15, 1906. A governor for fluid pressure systems for operating air brakes. Designed to open the circuit of the pumping motor abruptly when a certain pressure is attained. Has a piston acting on spring cam mechanism.

874,245. LAMP SOCKET; John J. Rooney, Scarsdale, N. Y. App. filed Jan. 10, 1906. A long tubular lamp socket especially for use with miniature lamps on Christmas trees.

874,250. FIRE ALARM AND SIGNALING DEVICE; Louis Sackwitz, St. Louis, Mo. App. filed May 14, 1907. A simple form of circuit-closing device including spring clips associated with a wooden block and held from moving into circuit-closing position by a fusible element.

874,284. GOVERNOR; Ira J. Babcock, Chicago, Ill. App. filed Nov. 7, 1906. A governor for air brake systems, including a spring-impelled piston displaced to move toggle levers into circuit closing relation when a predetermined pressure is attained.

874,293. CIRCUIT BREAKER; Frank W. Blair, New York, N. Y. App. filed June 19, 1906. A circuit closer of the plug and jack type for high potential circuits. Relates to detail features of construction.

874,345. TROLLEY; George Keresztes, Pittsburg, Pa. App. filed Sept. 6, 1907. The trolley wheel is made in the form of a long centrally grooved roller with spiral grooves extending from the central groove to maintain the wire constantly guided thereon.

874,357. ELECTRIC GAS LIGHTER; John Dickens, Passaic, N. J. App. filed April 2, 1907. Gas lighter, including a casing enclosing dry batteries and having transverse spring blades by which the circuits are automatically completed when the batteries are inserted.

874,372. ELECTRICAL SIGNALING DEVICE; James P. Williams, Latonia, Ky. App. filed June 6, 1907. Patentee has special trolley conductors between and beside the usual track rails and which are engaged by dependent brushes on the train.

874,374. APPARATUS FOR ELECTRODEPOSITING METALS; Wilhelm Muller, Offenbach-on-the-Main, Germany. App. filed May 13, 1904. Relates to the electro-deposition of metal for type-matrices. Covers complete construction of an apparatus for the above.

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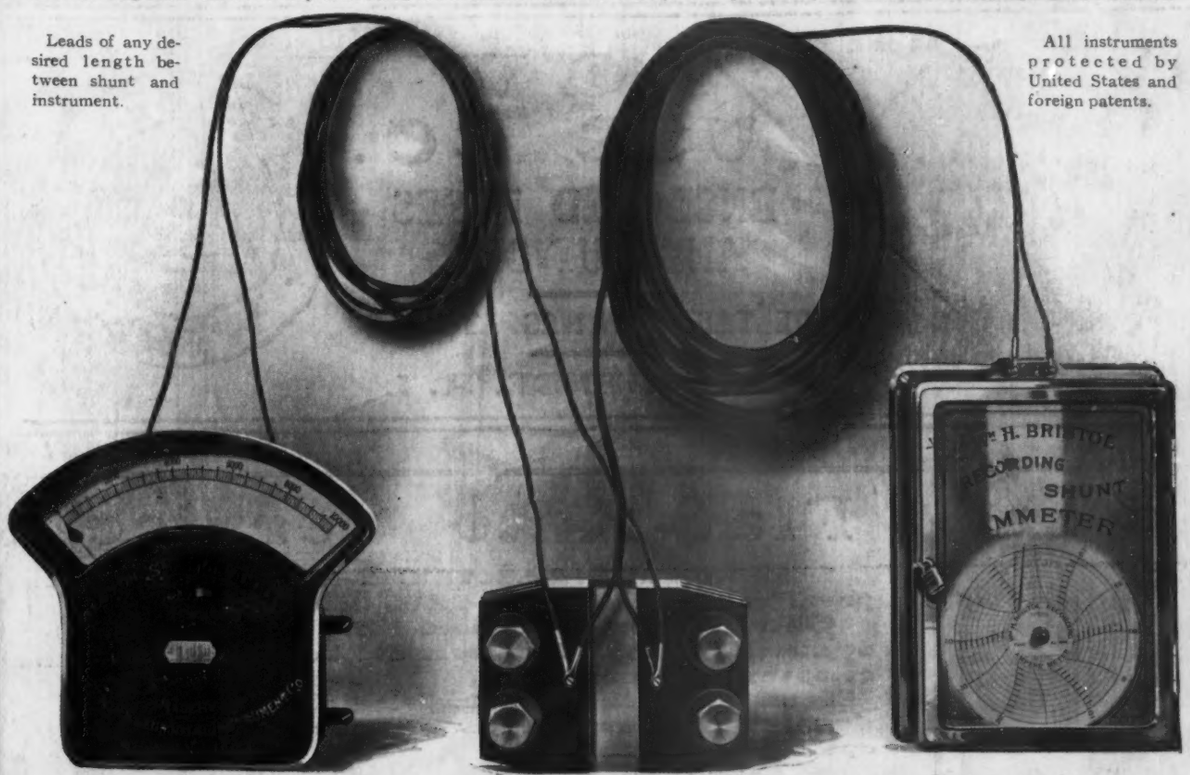

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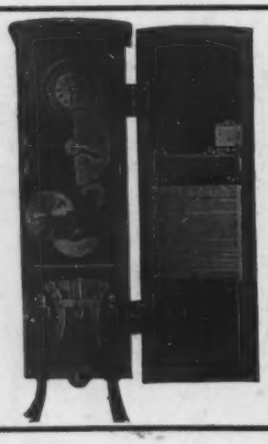

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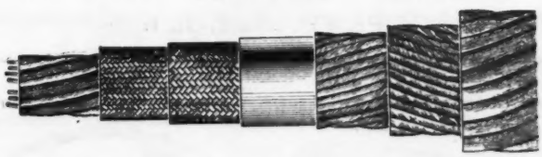

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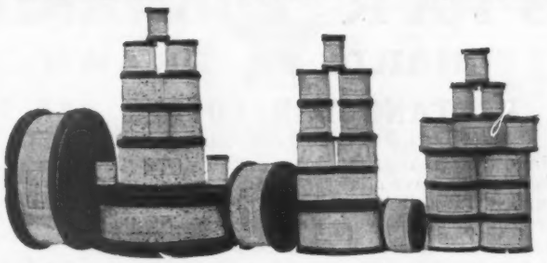

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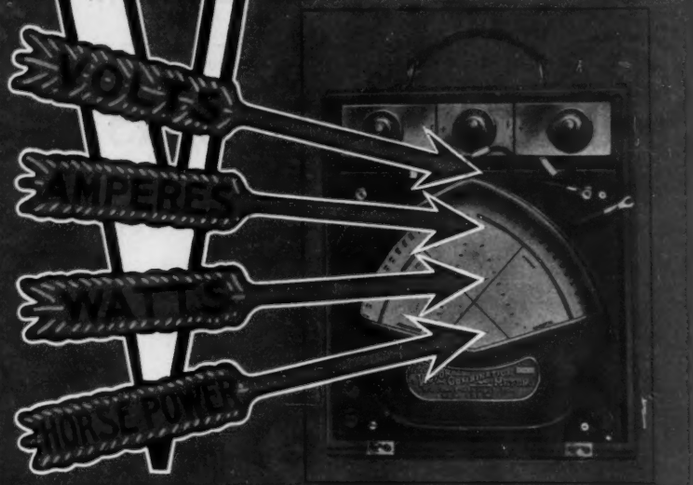

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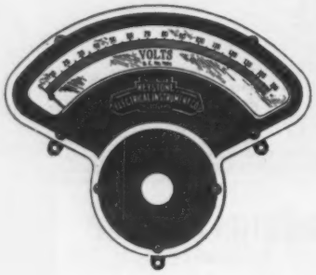

Choose a Type and Stick to It

It isn't necessary to have one type for your A. C. circuits and another for the D. C.

Keystone Instruments

offer a variety of designs common to both A. C. and D. C. service.

The D. C. instruments are built on the Deprez-D'Arsonval System, shielded from external fields. The voltmeters are unaffected by temperature changes. Ammeters provided with interchangeable shunts may be used on circuits other than their own in emergencies.

The A. C. instruments are constructed on the electro-magnetic system and all error due to lag or hysteresis is eliminated. Containing nothing subject to change, calibrations remain permanently correct.

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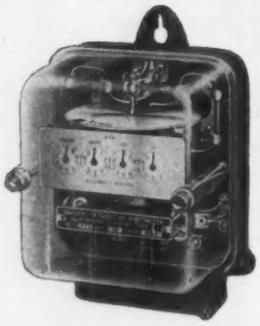
STILL TALKING



Yes, of course we are. The better one knows a Sangamo Meter, the greater one's enthusiasm over its merits becomes, and we are fairly familiar with the goods by this time.

Can't we persuade you to get familiar, too? It will be to your advantage as well as ours whatever the size or character of your plant may be.

The eating proves the pudding. Try some.

SANGAMO

SANGAMO ELECTRIC CO., Springfield, Ill.

Whitney Portable Direct Current Ammeters with Separate Shunts

Our portable shunts give exactly the same drop as our switchboard shunts of like capacity, i. e., 50 millivolts at full load. Every instrument is thus a millivoltmeter of 50 millivolts range and each can be used to check any other. Note the way in which the leads are built into the meter in above cut. This plan does away with the variable resistance of two contacts and makes it impossible to lose the leads.

We supply these sets in all capacities. Send for prices.

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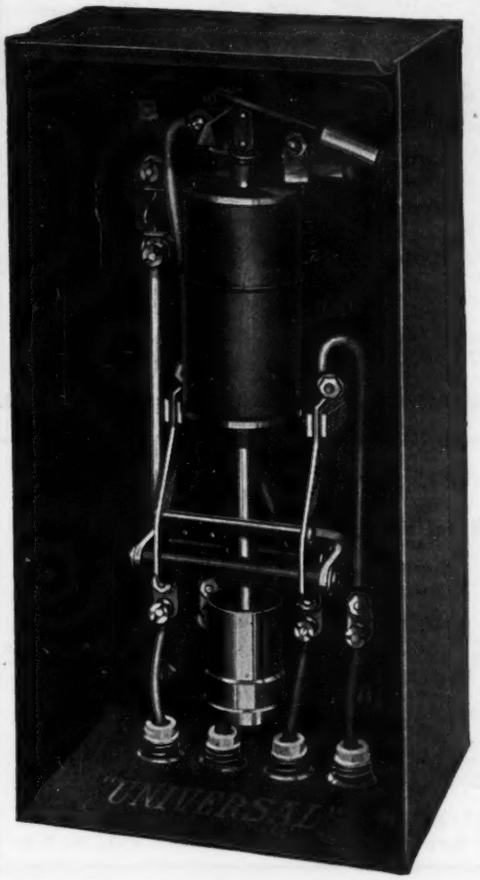

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The Universal Flat Rate Controller's System

OF SELLING JUICE?

IF NOT YOU OUGHT TO.

Write for one sample to-day on 30 days' trial and it will absolutely control your supply of current to *one* of your customers by switching current *off* and *on* at intervals of several seconds whenever he exceeds his contracted load by as much as one 8-c. p. lamp. It will restore uninterrupted service the moment *his* load is normal.

Write for quotations and reference.

Have you noticed our News Letter in the November 2d issue? If not, look it up; it will pay you.

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See our Exhibit at the Electrical Show, Chicago, January 13-25, 1908.

"KENT POCKET METERS" Are Standard and Most Reliable

"Dead Beat"—Accuracy Guaranteed.
Combination Volt-Ammeters.
0-6 volts, 0-30 amperes, price $6.00.
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Ampere Meters.
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Correspondence invited. Send for Catalog

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ELDREDGE BATTERY VOLTMETER

For Testing Primary and Storage Batteries, 0 to 3 volts, 0 to 6 volts, 0 to 10 volts.

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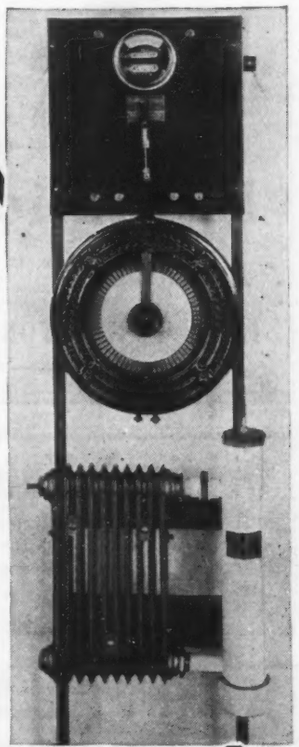
HICKLEY'S PATENT A. C. RECTIFIER

for transforming A. C. to D. C. Operates perfectly on any frequency or voltage. Has no mechanism to get out of order, no tubes to break; gives off no noise, smoke, fumes or odors. It requires no attention except to start and stop it; costs next to nothing for maintenance. No back charge possible. Only temporarily affected by interruption of A. C.—starts automatically when current again flows.



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The L. & N. Portable Testing Sets are convenient instruments for the accurate measurement of resistance and location of faults.

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Voltmeters
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Compact enough to fit the pocket.
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Send for catalog of portable and switchboard instruments.

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17 DIFFERENT SIZES

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For Electrical and Mechanical Purposes, Railway Dust Guards, Washers and Packings. Patent Insulating Cleats.

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MANUFACTURERS OF HIGH GRADE SINGLE AND MULTIPLE VITRIFIED SALT GLAZED CLAY CONDUITS

¶ MADE IN CONVENIENT SECTIONS FOR HANDLING AND LAYING, AND CAPABLE OF BEING LAID SO THAT CABLES MAY BE DRAWN AND WITHDRAWN WITHOUT THE SLIGHTEST INJURY TO THEIR OUTER COATING.
¶ MADE OF A MATERIAL THAT WILL NOT CORRODE AND DISSOLVE AMONG THE ACIDS AND ANY STRAY ELECTRICAL CURRENT THAT MAY SEEK AND FIND A PASSAGE ALONG IT.
¶ MADE IN ALL SIZES AND IN ALL STYLES OF CURVES OR BENDS.
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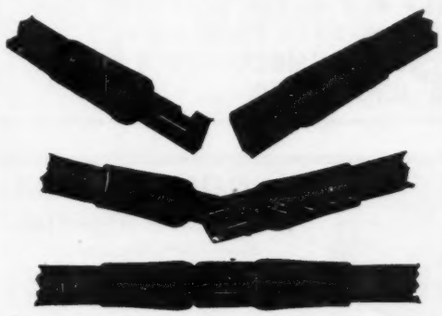
A Conduit Rod That Will NOT Break or Stick



Do you realize just what that means?

Do you realize that it means freedom from all vexations, breakdown delays; freedom from worry and extra expense?

But there are other advantages which you should know about, such as the fact that it cannot be negotiated at junk yards; such as the fact that it will always work freely, simply and easily, and last but not least—such as the very low price. Will you let us tell you more about them? Bulletin No. 2. Write to

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Vitrified Conduits

For a limited time we have a special advantageous proposal to submit to buyers expecting to require conduits during the coming season.

If you will write us we shall be glad to explain: you are then free to follow your own business judgment.

ROCHESTER SEWER PIPE CO.
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You should have our Pamphlet, "Conduit Specifications"

Orangeburg Fibre Conduit
is so made that it is practically a homogeneous mass.
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Ask any company whose wires are under ground, what their experience has been—

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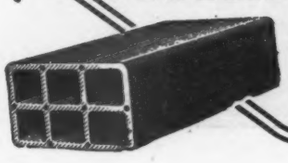

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Marlin Cable Hangers
Pure Long Fibre American Hemp
A T & T Specifications

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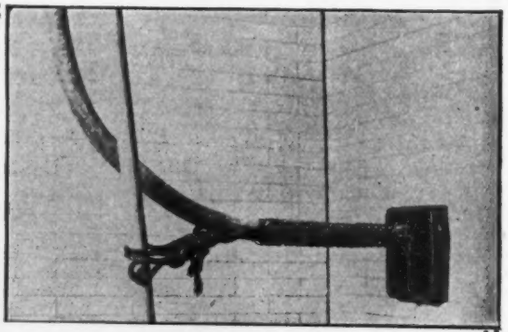
The Grip that can't slip.

For drawing cables through conduit, for pulling out slack.



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attach without loss of time, can't let go or damage the sheath, no time lost in detaching when you're through. Single and double eye, solid or split. We'll send some on trial to responsible parties who can use them.

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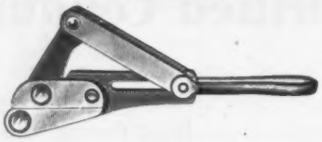
THE NEW "CHICAGO GRIP"



This grip has features that make it especially desirable. The gripping parts are forged steel, imparting strength and durability. The draw link is arranged so it is not in the path of the wire when placing the grip.
Send for catalogue of up-to-date tools.

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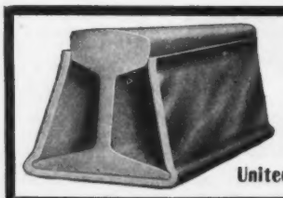

A PLIABLE OUTDOOR INSULATING MATERIAL
Absolutely unchanged by longest exposure to weather
FLEXIBLE AND ELASTIC
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This bit is made especially for electricians, telephone and telegraph work. Made of the best refined steel, will go through plastering and brick walls, won't be injured by coming in contact with nails, etc. Easily sharpened on an emery wheel or grindstone. Most durable, therefore, cheapest bit on the market.

Specify (H) Hargrave tools and you'll get the best in quality, finish and design.

Catalogue 441 describes them

The Cincinnati Tool Co.
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POLES Southern White Cedar, Octagonal Yellow Pine, Creosoted Yellow Pine | **CROSS ARMS** | Best Georgia Long Leaf Pine
Any size or quantity
Southern Exchange Company
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Buy Direct from the Producers
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Hot, cold wet or dry

IT INSULATES:

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It radiates heat.
It is absolutely non-carbonizing.
It can be used anywhere on any electrical device.
It is furnished in paper or tape.
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Here's a mighty good Lamp Guard

STYLE "A"

and we make a complete line, every one as good.

It's better than other lamp guards of its type. Our booklet tells why. The guard itself proves why. This and other

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are all a success.

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New Profits Are Appearing

daily when good and reliable transformers are on your lines.

Moloney Transformers

minimize the daily losses—keep them within the bounds of economy.

If you care to show a clear profit from your plant, watch out for the leaks—be able to account for the current consumption—in other words, install Moloney Transformers and know how you stand.

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BRANCH HOUSE: FORT WORTH, TEXAS. 3

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TEATS ON THE PETTICOAT

They take all the moisture from the inner and outer surface of the insulator and keep the pin dry.

HEMINGRAY GLASS COMPANY

Established 1848 } COVINGTON, KY.
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Factories, - - MUNCIE, INDIANA.

Very Attractive Prices

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Cat. No. 9405. 5000 V.

We are in a position to quote very low prices on **LOW VOLTAGE PORCELAIN INSULATORS** for

TELEPHONE, ELECTRIC LIGHT and RAILWAY FEEDER WORK

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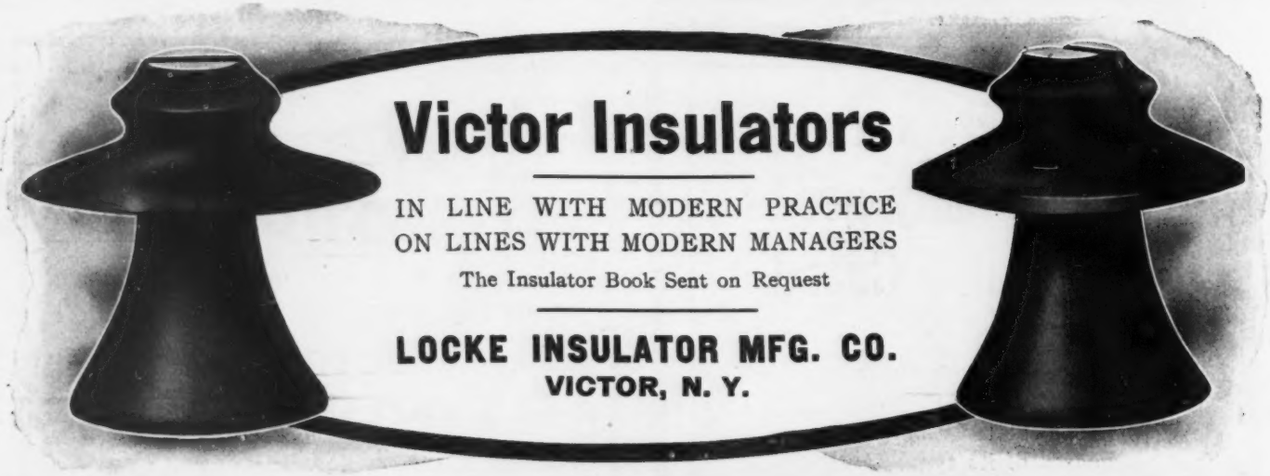

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IN LINE WITH MODERN PRACTICE
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THE BEST THAT CAN BE MADE

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This shows Standard Type B (Pat.) for use with small standard insulators. Cast from copper bronze or malleable iron with steel carriage bolts. Other types for every service.

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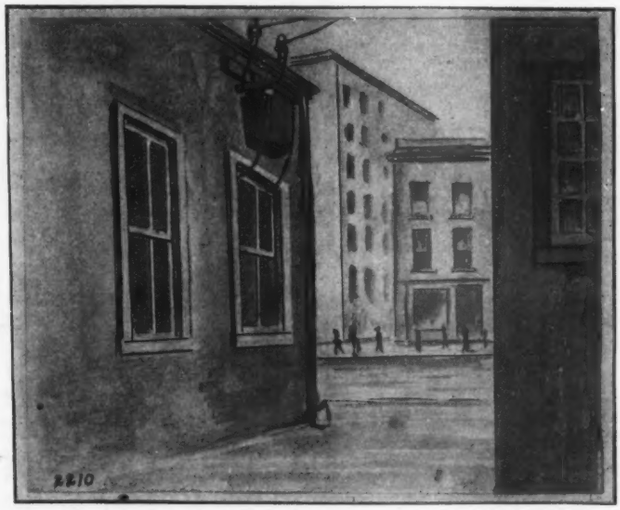

Mr. Central Station Manager:

This will catch your eye just about the time you are making preparations to take account of stock and close your books covering 1907 business.

In making your report to your Board of Directors do not overlook the fact that you can cut down your stock of transformers materially by using Wagner "High Efficiency" or "Standard" types, on account of their "2 in one" features. These transformers will enable you to carry lighting and motor loads, separately or in conjunction, without interference one with the other.

Another point to incorporate into your report would be your recommendation for the extension of feeders as single-phase. This will save you money in line wire, cross arms, insulators, time and transformers.

You can guarantee to handle any ordinary load with Wagner Single-Phase Motors, thus making it unnecessary for you to have three-phase feeder circuits.

YOUR REPORT SHOULD COVER THESE POINTS

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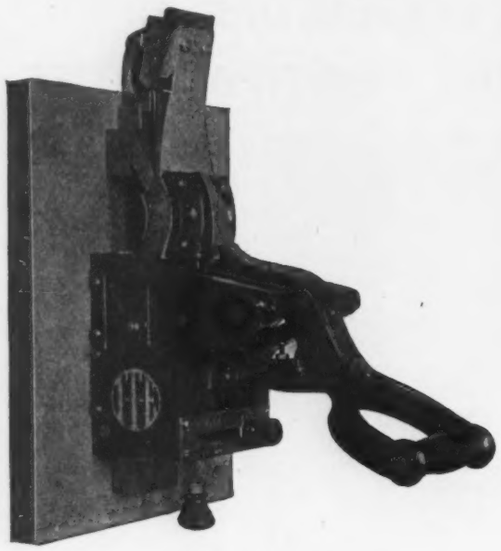
Bulletin No. 78-D, Transformers Bulletin No. 75-D, Single-Phase Motors

See our exhibit at the Electrical Show, Chicago, January 13-25, 1908

The use of an
I-T-E CIRCUIT BREAKER
saves money, time and trouble



I-T-E Laminated Circuit Breaker
"N-X" Type, Single Pole
250 Volts or Less, Direct Current

THE simplest form of circuit breaker is the Overload Type. Properly installed, its operation effectively limits the current to a predetermined amount, indicated by the setting or adjustment of the circuit breaker. As its name implies, it opens upon excessive currents or short-circuits, such as may occur from any one of a thousand causes. It opens instantly and can be as instantly reset.

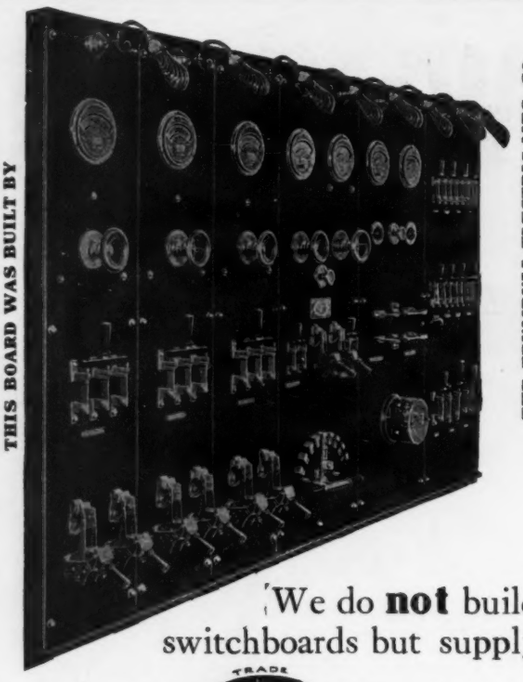
The cut shows a type of I-T-E Circuit Breaker designed for the protection of generators.

WHEN the product of a responsible manufacturer is favorably known all over the world; when you can get just exactly what you want, and when you want it, at the right price, why take chances in the use of less efficient and practically unknown apparatus? The more you know about circuit breakers in general, the more you will insist upon having I-T-E CIRCUIT BREAKERS in particular.

The CUTTER CO., Philadelphia

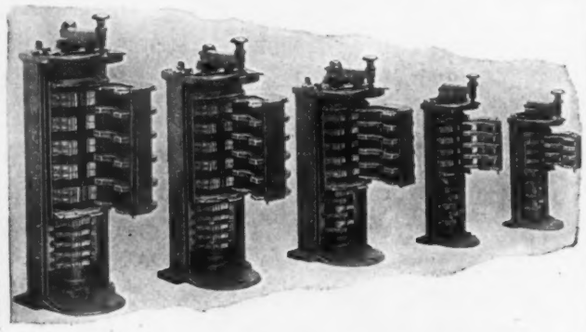
120 Liberty Street, - - - New York
636 Marquette Building, - Chicago, Ill.
1406 Machesney Building, Pittsburg, Pa.
1613 Chemical Building, St. Louis, Mo.
766 Folsom Street, San Francisco, Cal.
The I-T-E Electric Co., Ltd.
72 Finsbury Pavement, London, E. C., England

THIS BOARD WAS BUILT BY THE TRUMBULL ELECTRIC MFG. CO.



We do **not** build switchboards but supply Circuit SE Breakers to those who do.

The Switchboard Equipment Co.
Bethlehem, Pa.



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The Von Zweigbergk Controller Co.
Works, Cleveland, Ohio
General Sales Office, 20 Broad St., New York
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PACIFIC ELECTRIC AND MFG. Co.
Pole Line
Cut-Out Switches for Any Voltage
Oil Switches for Voltages from 30,000 to 100,000
701 Atlas Building
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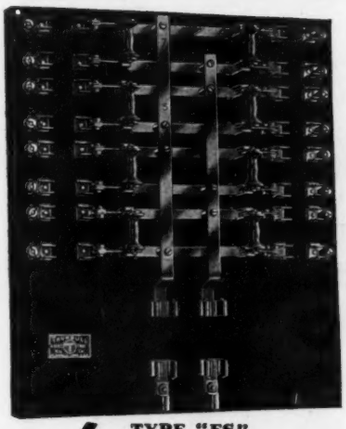

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TRUMBULL PANEL BOARDS

Our Panel Boards have long since been recognized as one of the best types of Standard Boards.

We catalog a regular line for N. E. C., Plug, and Open Link Fuses, with or without Switches. We are prepared to make, at reasonable prices, all kinds of Special Boards.

LET US QUOTE YOU.

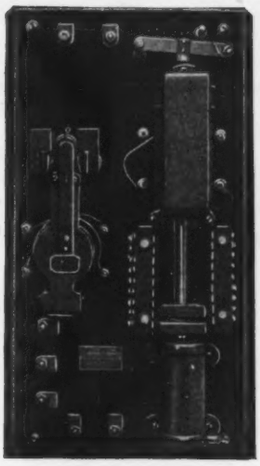
The Trumbull Electric Mfg. Co.

NEW YORK 136 Liberty St. Plainville, Conn. BOSTON 65 & 67 Oliver St.

WARD LEONARD

"CS" type, no-voltage release; automatic switch and protective interlock, preventing the closure of the motor circuit except when all the starting resistance is in series with the armature.

Used to start any type of direct current motor.



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YOU
Press the Button
IT
Does the Rest

Typical Prices

H. P.	Volts	List Price	
1/2	All	$30.50	In stock
3	All	40.00	In stock
5	All	43.00	In stock
10	All	60.00	In stock

Order to-day. All sizes in stock. Save time and money.

Ward Leonard Electric Co.
BRONXVILLE, N. Y.

THE F. BISSELL COMPANY
226-228-230 Huron Street, TOLEDO, OHIO.
Bulletin No. 19
November, 1907
Direct Current Security Switchboards
Switchboards shown and listed herein cover the usual requirements of 125 and 250 volt direct current service for isolated and central station plants.

Switchboards of the Better Kind.

"Quotations on the Spot"

WITH our new Switchboard Bulletin you are at once able to arrive at intelligent and business getting prices. We illustrate each different type of board. We are originators of these features.

¶ Bulletin will be mailed you on request.

¶ Write to-day — to-morrow you'll forget.

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No Sliding Contacts

Small Space

Its Value Has Been Demonstrated

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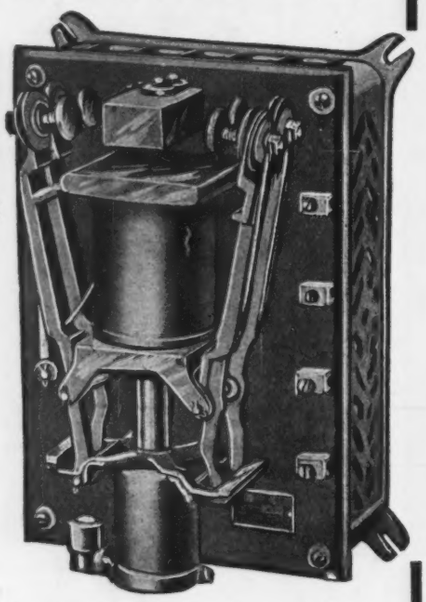

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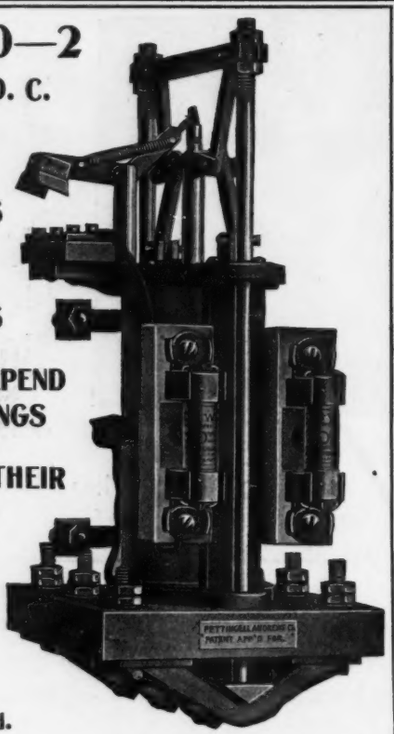
REMOTE CONTROL SWITCHES HAVE LAMINATED CONTACTS AND DO NOT DEPEND UPON SPRINGS TO COMPLETE THEIR OPENING OR CLOSING MOVEMENT



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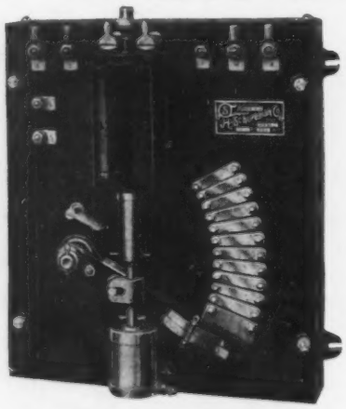
for Electric Pumps, Compressors, Etc.



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We manufacture a complete line of Automatic Starting Devices, also Elevator Controllers, Distant-Control Switches and Manually-Operated Starters for large motors.

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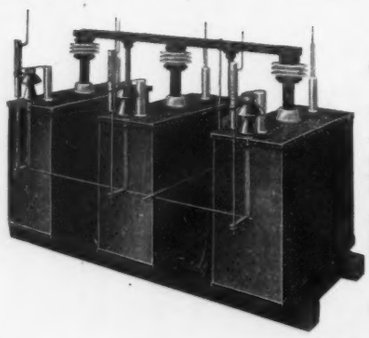
Kelman's High Voltage Switches AND Circuit Breakers



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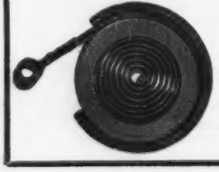

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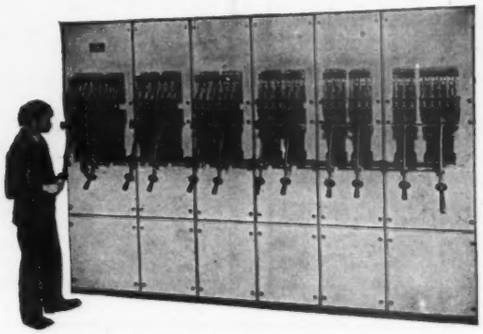
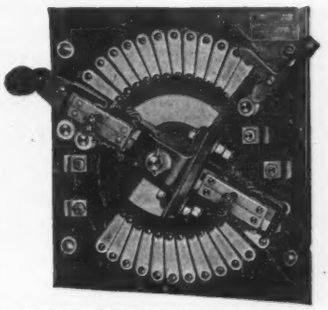
¶ The Cutler-Hammer line of Motor Starting Rheostats offers the widest possible range for selection. We carry constantly in stock 6000 motor starters and speed regulators for immediate delivery.

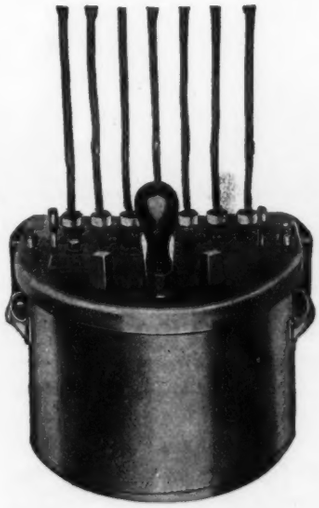
Motor Starting Rheostat with no-voltage release. (Bulletin 10.)



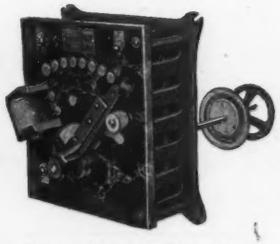
Multiple Switch Starting Rheostat for 1500 H. P. Motor. (Bulletin 10½.)



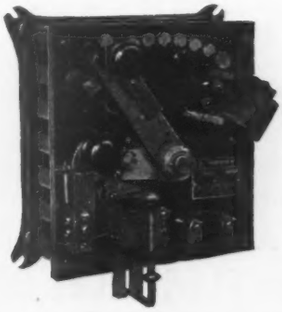
Starting Rheostat for induction motor—squirrel cage type. May be used in place of auto-transformer or compensator with small motors. (Bulletin 18.)



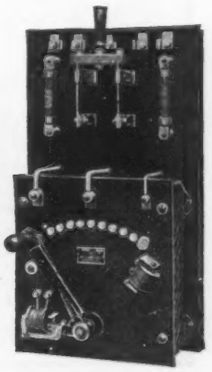
Oil immersed Auto-transformer, or Compensator, for starting large squirrel cage type, induction motors. (Bulletin in preparation.)



Motor Starting Rheostat for rear of switchboard mounting. (Bulletin 16.)



Double Lever Motor Starting Rheostat. Moisture proof resistance. (Bulletin 17.)



Universal Motor Starter. (Bulletin 21.)

Full particulars regarding Cutler-Hammer Motor Starting Rheostats and more than 2500 types and sizes of other standard electric controlling devices are given in our complete catalog—free on request to those who really hav occasion to use it.

THE CUTLER-HAMMER MFG. CO.

MILWAUKEE, WISCONSIN

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CHICAGO OFFICE: Monadnock Block

PITTSBURG OFFICE: Farmers' Bank Bldg.

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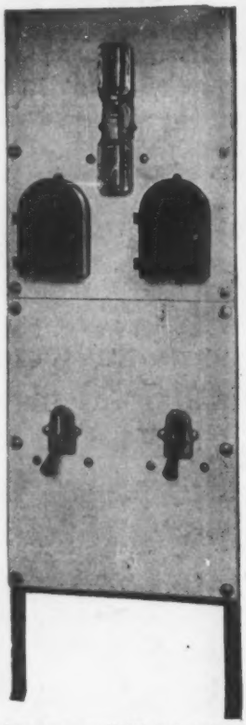
High Tension Automatic Time Switch



(Upper panel) High tension automatic time switch

designed for throwing a high voltage circuit on and off at stated times each day. Requires no attention other than winding the clocks once a week. The solenoids are operated from the main circuit, and no auxiliary circuit is required to operate the oil switch. The oil switch used is one of our type G, 3300-volt switches, shown in the manually operated form on the lower panel of the cut.

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Hartman Circuit Breaker Co.
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In your specifications mention

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And you will always get goods as ordered.

High Tension, Weatherproof, Oil Break Switches For 3,000-4,600 and 6,900 Volt Systems

For current capacities ranging from 60 to 300 Amperes.
These Switches are built in S.P.D.P., and T.P. and 4 Pole Single Throw, and S.P. and D.P. Double Throw.
For overhead or underground systems.

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HIGH TENSION ELECTRICAL SPECIALTY COMPANY, .. Newton, Mass.

Insulated Staples
4 Sizes
Pat. Nov., 1900

BLAKE
Tube Flux for Soldering

Full Size of Tube 1" x 5"

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FOR USE ON PLASTERING

EXACT SIZE PAT. JULY 1906

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Three Days More

and then you'll begin to turn over a new leaf; you'll "cut out" this, and you'll "cut out" that; you'll plan to do all sorts of good things, and "cut out" the bad habits. But speaking of "cut outs," you want to keep in mind during the coming year, that

Bossert Cut-out Boxes

should be your choice just as much as ever—you can't do your best work without them, and it would be absurd to try to give them up. However, we won't "talk shop" now, but to all of you electrical men, whether you use Bossert Boxes or not, we wish you a mighty Happy and Prosperous New Year.

"CUSHING"

Single and Double Circuit

STAGE POCKETS

50 Amp. 125 Volts Unfused

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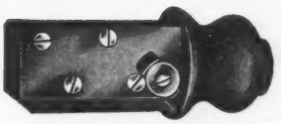

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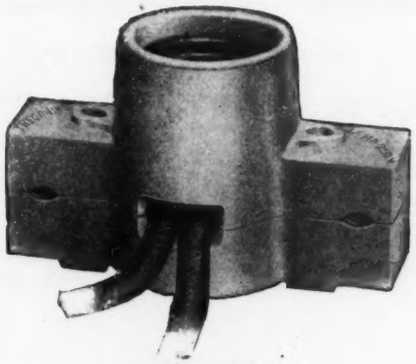

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Combination Cleat and Weatherproof Receptacle

Here is another one of our line of lighting specialties, which will not only reduce the cost of labor of installation, but also a saving in cleats and wood screws necessary to install the direct connected receptacles which you have been using. This Receptacle can also be used for suspension work, a galvanized iron hook and two machine screws being provided with this construction. Catalogue and prices will be submitted upon application.

THE TREGONING ELECTRIC MFG. CO.

Cleveland, Ohio

Can't get Out of Order: SORENSEN'S CEILING SWITCH

Easy and positive action secured by using a UNION JOINT. Handle prevented from working loose by means of a left-hand thread. Short circuits prevented by operating with a cord. Switch trouble prevented by using a "Diamond H" Snap Switch. Two screws fasten it to the ceiling. Approved by the Fire Underwriters. It's perfect—so is the price.

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The Contractor's Reputation

IS TOO VALUABLE AN ASSET TO RISK.

"DIAMOND H" SWITCHES

Push Button Switch in Steel Wall Case

protect the contractor's reputation and make new customers by satisfying old ones.

High quality is one of their distinguishing features, contributing to economy, reliability and safety.

Rotary Flush Switch in Steel Wall Case

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3

THE
WEBER SOCKET
IS A TIME AND MONEY SAVER

National Code Standard--Approved

(Patents protected by Patent Title & Guarantee Co., New York)

No screw-driver necessary to take apart for wiring, nor to put together afterwards.

Shell is locked securely to cap and will not become loose and drop down on lamp.

Mechanism cannot become loose and allow lamp to burn after current is turned off.

HENRY D. SEARS
General Sales Agent
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ALWAYS AHEAD
NEW YOST SOCKET

We originated the Snap Lock. Now note the latest feature. See that Bead under the cap edge? Adds Strength and Beauty: Better get full particulars.

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Winter Nights

keep folks home around the family table. The modern family table is lighted with an electric lamp. Show your present and future customers samples of our electric and combination lamps and they'll buy more current. *Better see our Catalog.*

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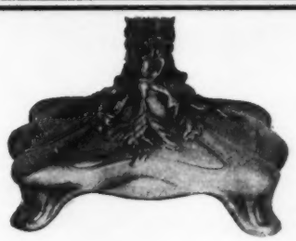

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FREE TO DEALERS ONLY.

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Installed in over 20,000 Churches
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for the invalid and the comfortable bed reader.
It attaches to bed and throws light in any direction.

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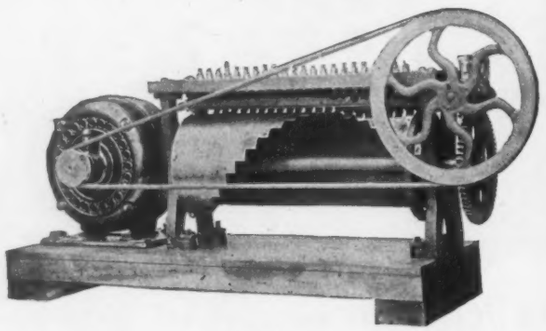

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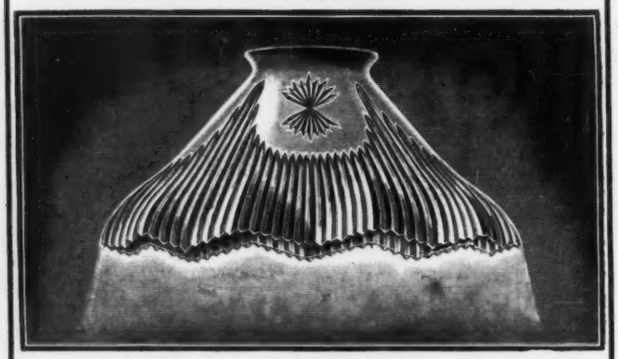

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Flashes regularly. Built for hard service

BELL RINGER, $9.00 LIST

A low-voltage transformer. Lamp lights when secondary circuit is closed only. Allows regulation of current and acts as a trouble finder.

Electric Light Co. will ring the bells.

Throw away the batteries, and confidence will be restored.

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Rat Chasing Flashers "RECO"

They give the running rat or serpent effect to borders of electric signs. This is the latest idea in electric sign displays and is proving a wonderful attraction everywhere. The RECO Flashers are constructed very durably and simply and are free from all troublesome parts. Send us full details of such a sign as you may contemplate to install, and we shall be pleased to quote you special price on a RECO Rat Chaser for controlling it. Write us to-day and ask for free booklet.

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ELECTRICAL SUPPLIES

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Metallized Filament

High Efficiency Types

2 1-2 Watts per Candle

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50-Watt Type

Our Renewed Electric Lamps, made by a factory that is absolutely independent of the Trust, are now known from Maine to California. They are NOT ETCHED "RENEWED," neither do we hold you to a Trust schedule of prices, as is required of the Trust's licensee factories. We will shortly announce something of special interest to lamp users, in these columns!

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"WOLFRAM"

Highest Efficiency Incandescent Lamps

35 BETHUNE STREET, NEW YORK

Local Agencies Desired Liberal Terms

THE TALKING SIGN

Flashers, Time Switches, Good Electric Signs.

THE ELECTRIC MOTOR AND EQUIPMENT CO.

NEWARK, N. J.

The Tungsten Lamp

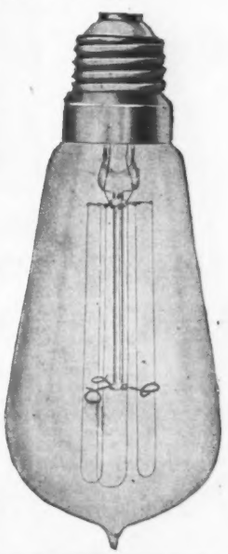
Patents granted and pending in all countries

One Watt Per Candle

70% Saving

Shipped safely any distance

Prompt shipment from New York



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The Electrical Accessaries Company

Sole Distributors for the American Continent

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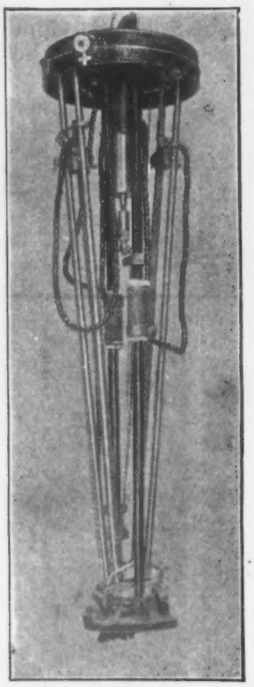
The Original Beck Flamer

THE GREATEST ELECTRIC ARC LIGHT IN THE WORLD



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Alternating and Direct Current, Multiple or Series Installation.

10 Amperes, 45 Volts, 450 Watts. 3000 Candle Power.

Old Style Arc consumes 5 Amperes, 80 Volts, 400 Watts. 600 Candle Power.

Selling Agents, capable of Installing and Demonstrating, wanted everywhere west of the Rocky Mountains.

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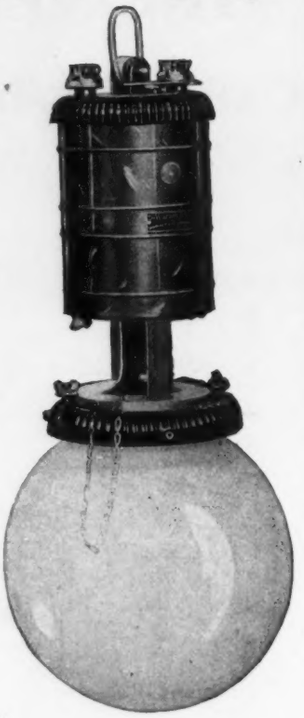
Warner Enclosed Arc Lamps

for multiple burning on 110 or 220 volt D. C. circuits.

The absence of delicately adjusted pivot and knife-blade bearings in this lamp appeals to those familiar with Arc lamps as applied to service. The Fireproof construction and interchangeable features are of too much importance to central station managers to be overlooked by them.



Manufactured by the

Warner Arc Lamp Co.

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LILIPUT 1/10 of actual size

Modern Against Antiquated Illumination

True Light Against False Light!

The various types of lamps, partly imported, partly manufactured by me, give from 60 to 150% more light than ANY of the old-style lamps without consuming more current.

Liliput Arc Lamps, 2 and 3-Amp., D. C. and A. C. (Siemens). One 3-Amp. D. C. *Liliput* gives more light than any 5-Amp. old-style lamp. Pure white light.

"Radiante" and "Economy" Lamps, 5-Amp., D. C. only. *One* of these lamps gives more light than *two* of the best old-style lamps. Spectrum identical with sunlight.

"Helia" Lamps, 5-Amp., for A. C. New.

The *original* FLAMING ARC LAMPS, D. C. and A. C., 3500-4000 C. P. each. (Manufacture and sales protected under 13 U. S. letters patent.)

N. B.—This is the ONLY house in the U. S. handling exclusively high-grade novelties for electrical illumination.

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N. B.—Carbons for all kinds of FLAMING ARC Lamps carried in stock.

Are you particular?

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Brilliant, steady illumination; silent, efficient operation; long carbon life; ease of adjustment and cleaning; handsome weatherproof case—these are some of the features that make the lamp so popular. Our bulletins describe every detail. Write for a set.

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YOU know that Arc Lamps are one of the most economical forms of converting electricity into light.

Many times, however, low ceilings prevent the use of Arc Lamps on account of their long length, but we have entirely overcome this objection in our

"HAWTHORNE SHORT ARC LAMP"

It's only 20 inches long. It burns without a flicker and can be adapted to either direct or alternating-current circuits. It burns

Over 100 Hours without trimming

We will be glad to give you figures on equipping your plant with Arc Lamps; and will send you our Bulletin No. 7035-A on request.

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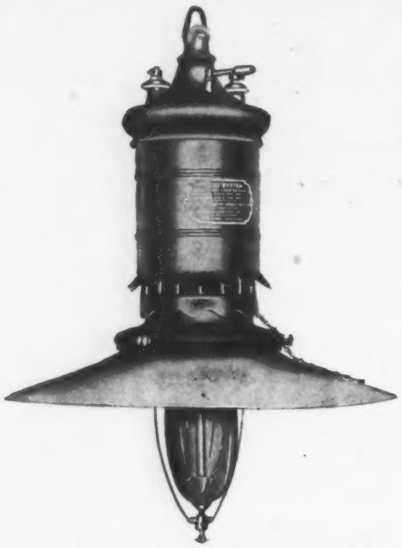

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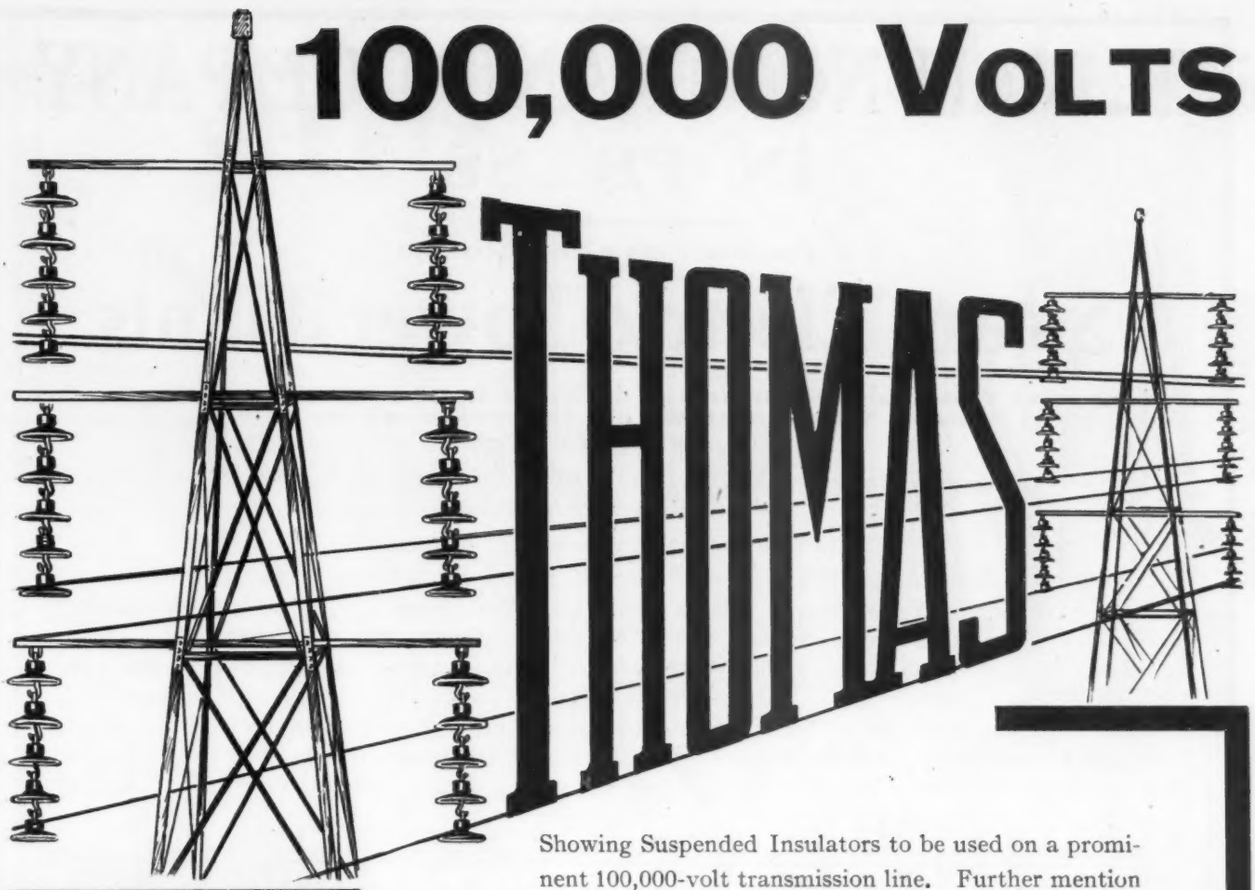

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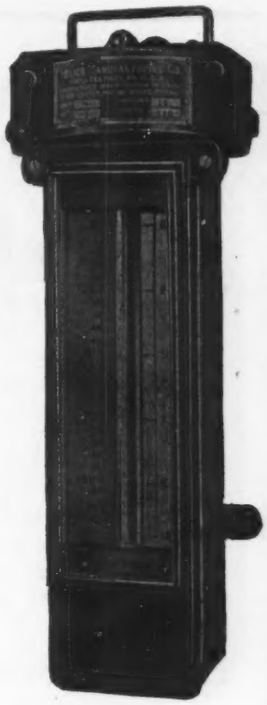

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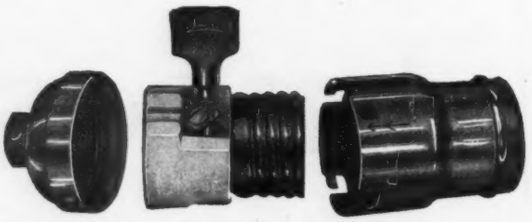

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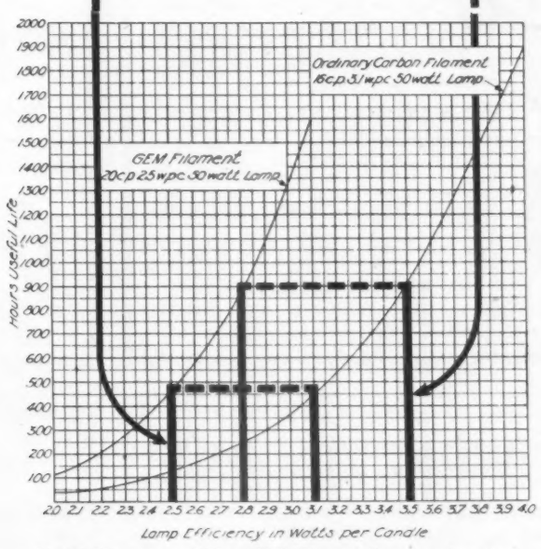

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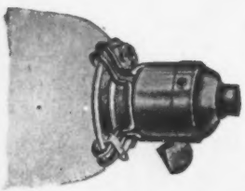

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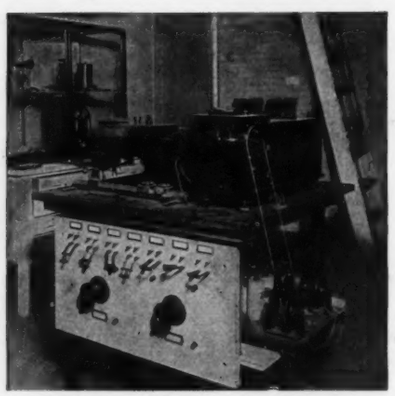

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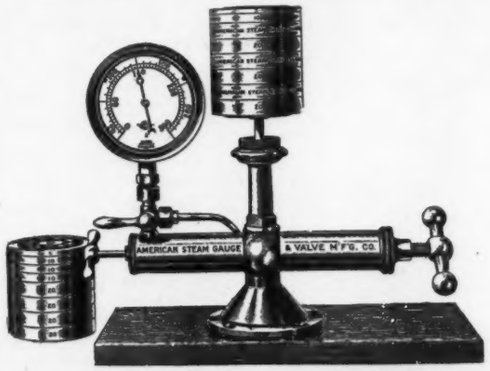

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Edison Mfg. Co.
Electric Goods Mfg. Co.
Manhattan Electrical Supply Co.

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Electric Storage Battery Co.
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Gould Storage Battery Co.
National Battery Co.
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Manhattan Electrical Supply Co.
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Shultz Belting Co.

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Bossert Electric Construction Co.

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Central Laboratory & Supply Co.
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Thomas & Sons Co., R.

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Electric Service Supplies Co.
Massachusetts Chemical Co.
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Standard Asphalt & Rubber Co.
Standard Paint Co.
Sterling Varnish Co.

Composition Cloth and Paper.
Anderson Mfg. Co., A. & J. M.
Green Insulation Co.
Hollingsworth & Vose Co.
Johns-Manville Co., H. W.
Mica Insulator Co.
Munsell & Co., Eugene.

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Diamond State Fibre Co.
Kartavert Mfg. Co.
United Indurated Fibre Co.
Vulcanized Fibre Co.

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Hemingray Glass Co.

Lava.
American Lava Co.
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Mica Insulator Co.
Munsell & Co., Eugene.

Silk.
Ryle & Co., William.

Staples.
Blake Signal Mfg. Co.

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New York Insulated Wire Co.
Okonite Co., Ltd.
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Hemingray Glass Co.
Locke Insulating Mfg. Co.
Ohio Brass Co.

JACKS.
Watson-Stillman Co.

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Anderson Mfg. Co., A. & J. M.
Excello Arc Lamp Co.
Fort Wayne Electric Works.
General Electric Co.
General Light Improvement Co.
Hamburger, Felix.
Helios Mfg. Co.
Stuart-Howland Co.
Warner Arc Lamp Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

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Electrical Accessaries Co.
General Electric Co.
Hill-Wright Elec. Co.
Jaeger Miniature Lamp Mfg. Co.
Klein, Jr., P. H.
Stuart-Howland Co.
Union Electric Co.
Warren Electric & Specialty Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.
Westinghouse Lamp Co.

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Excello Arc Lamp Co.
Hamburger, Felix.
Helios Mfg. Co.
Klein, Jr., P. H.
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Jaeger Miniature Lamp Co.

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Electric Service Supplies Co.
Westinghouse Elec. & Mfg. Co.

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Clark Elec. & Mfg. Co.
Electric Service Supplies Co.
Ohio Brass Co.
Pacific Elec. & Mfg. Co.

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Jeffrey Mfg. Co.

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MAGNET WIRE.
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Baker & Co., Inc.
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General Electric Co.
Jeffrey Mfg. Co.

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Central Laboratory & Supply Co.
Knapp Electric & Novelty Co.

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Cincinnati Tool Co.

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OILING DEVICES AND SYSTEMS.
Lunkenheimer Co.

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American Platinum Works.
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Hubbell, Inc., Harvey.
Tregoning Electric Mfg. Co.

POLES, ARC LAMP.
Mott Iron Works, J. M.

CLASSIFIED INDEX—Continued.

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Humbird Lumber Co.
Kellogg Switchboard & Supply Co.
Sand Point Cedar & Pole Co., Ltd.
Southern Exchange Co.
Stuart-Howland Co.

PORCELAIN. (See Insulating Material, China and Porcelain.)

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Link-Belt Co.
Robins Conveying Belt Co.

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Watson-Stillman Co.

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Deane Steam Pump Co.
De Laval Steam Turbine Co.
Emerson Elec. Mfg. Co.
Quimby, Wm. E.
Tacony Iron Co.
Watson Machine Co.

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De Laval Steam Turbine Co.
Deming Co.
Goulds Mfg. Co.
Luitwieler Pumping Engine Co.

PUMPS, VACUUM.
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Clark Elec. & Mfg. Co.
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Goodwin & Kintz.
Phoenix Glass Co.

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Gregory Electric Co.
Heck, Louis.

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Universal Electric Stage Lighting Co.

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Sears, Henry D.
Tregoning Electric Mfg. Co.

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Sears, Henry D.
Yost Electric Mfg. Co.

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Cary Spring Works.

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(*Continued on page 76.*)

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View of Alternators, Gregory Electric Co.

60-Cycle Alternators

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1 40	West'g'h'se, single ph.
1 45	West'g'h'se, single ph.
1 50	Westinghouse, 2 phase.
1 50	West'g'h'se, single ph.
1 60	Westinghouse, 2 phase.
1 60	West'g'h'se, single ph.
1 75	Westinghouse, 2 phase.
1 75	Westinghouse, single ph.
1 120	Gen. Elec., type A. M., monocycle, single ph.
1 150	West'g'h'se, single ph.
3 180	Gen. Elec., type A. S., single phase.
1 300	Gen. Elec., 3 phase, type A.T.B., 10,000 volts, with switchboard.
1 300	Gen. Elec., 3 phase, type A. T. B., 3 bearings, 2,300 volts.

125-Cycle Alternators

K. W.	
1 18	T.-H., type A. 18.
1 30	Gen. Elec., A. 30.
2 50	Ft. Wayne, type W.A.L.
1 60	Westinghouse.
2 60	Gen. Elec., type A.S. 60.
1 70	T.-H., type A. 70.
1 75	Ft. Wayne.
2 120	Gen. Elec., type A. 120.
1 120	Gen. Elec., type A.S.120
1 150	Stanley, 2 phase.
1 150	Ft. Wayne, type W. A.
2 200	Ft. Wayne, type W.A.L.
1 300	Stanley, 2 phase.
1 350	Stanley, 2 phase.

Three-Phase

25-Cycle Alternators

K.W.	
1 85	West'g'h'se, 440 volts.
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1 7½	Gibbs, M.P.
1 11	Eddy, M.P.
1 12	Edison.
1 12½	Milwaukee, M.P.
1 12½	Gen. Elec., M.P.
2 11½	Westinghouse, M.P.
3 13	Crocker-Wheeler, M.P.
1 15	Bullock, M.P.
1 17½	Gen. Elec., M. P.
1 20	Columbia, M.P.
1 20	Commercial, M.P.
1 20	Western Electric, M. P.
1 20	Fisher, M. P.
1 20	Card, M.P.
1 22½	Westinghouse, M. P.
2 30	Eddy, M.P.
1 35	Milwaukee, M.P.
1 35	Card, M.P.
1 40	Western Elec., M.P.
1 40	Bullock, M.P.
1 40	Triumph, M.P.
1 40	National, 6-pole.
1 40	Western Elec., M.P., d. c. to 8"x12"x16" vertical Williams comp. engine.
1 50	Bullock, M. P.
1 55	Gen. Elec., Form H., M. P.
1 56½	Westinghouse, M.P.
1 75	Northern, M.P.
1 60	Western Elec., 6-pole, d. c. to Russell 12" x 12" engine.
1 75	Westinghouse, d. c. to 12"x20"x12" Westinghouse comp. engine.
1 100	Eddy, M.P.
2 100	Triumph, M.P.
1 100	Westinghouse, M.P.
1 130	Gen. Elec., d. c. to 14"x16" Ideal engine
1 150	Western Elec., d. c. to 16"x25"x14" cross compound Ball & Wood engine.

220 to 250 Volt Generators

K.W.	
1 7½	Westinghouse, M. P.
2 12½	Gen. Elec., M.P.
1 13½	Gen. Elec., M.P.
3 17½	Gen. Elec., M.P.
1 20	Siemens & Halske, M. P.
1 20	Bullock, M.P.
1 27	Crocker-Wheeler, M.P.
1 35	Western Elec., M.P.
1 35	Northern, M.P.
1 45	Westinghouse, M.P.
1 50	Milwaukee, M.P.
2 60	Milwaukee, M.P.
1 100	Thompson-Ryan.
1 100	Ft. Wayne, M.P.

500-Volt Generators

K.W.	
2 30	Westinghouse, M.P.
1 33	Westinghouse, M.P.
1 55	Gen. Elec., M.P.
1 60	Westinghouse, M.P.
1 80	Westinghouse, M.P.
3 100	Gen. Elec., M.P., 100.
1 100	Ft. Wayne, Wood.
1 100	Westinghouse, 6 pole.
1 120	Westinghouse, M.P.
1 150	Westinghouse, 6 pole.
1 200	Westinghouse, 6 pole.
1 250	Northern, 6 pole.
2 500	Westinghouse, M.P.
1 500	Westinghouse, 6-pole.

Arc Machines

1 100	lt., 9.6 amp., Brush, 5000 volt, No. 10.
1 50	lt. T.-H., 9.6 amp., self-oiler, with ring armature.

ELECTRICAL APPARATUS FOR IMMEDIATE SHIPMENT

A. C. Direct Connected Units.

1—500 K.W. 2 or 3 phase, 60-cycle, 2300-volt Westinghouse, 150 R. P. M., engine type.

1—300 K.W. 2 or 3 phase, 60-cycle, 2300-volt Westinghouse, 150 R. P. M., with vertical C. C. Williams engine.

1—150 K.W., 3-phase, 60-cycle, 2300-volt General Electric—Revolving field with Ames horizontal simple engine (18" x 16").

2—200 K.W. 3-phase, 25-cycle, 480 volt General Electric—Revolving field with Ball & Wood horizontal engines (17 x 16).

1—150 K. W. 2-phase, 60-cycle, 220-volt Westinghouse with Ball & Wood 4-valve horizontal engine (22 x 16).

D. C. Units, Direct Connected.

1—100 K. W. 125-volt, 6-pole Western Electric 230 R. P. M. with 17 x 15 Syracuse St. Line engine.

1—15 K.W. 125-volt, 4-pole Eddy—325 R. P. M. with 8 x 10 Ball & Wood engine.

Belted A.C. Generators.

1—240 K.W. Westinghouse, 2 ph., 60 cy., 2300 v.
1—180 K.W. Stanley, 2 ph., 60 cy., 2300 v.
1—135 K.W. Stanley, 2 ph., 60 cy., 2300 v.
1—100 K.W. G. E., 2 ph., 60 cy., 2300 v.
1—200 K.W. Ft. Wayne, 1 ph., 133 cy., 2300 v.
1—150 K.W. Westinghouse, 1 ph., 60 cy., 2300 v.
1—90 K.W. G. E., 1 ph., 60 cy., 2300 v.

Belted D. C. Dynamos.

1—300 K.W. Northern Electric, 250 volts, 360 R. P. M.
1—62 K.W. T. H., 250 volts, 900 R. P. M.
1—65 K.W. G. E., 125 volts, Form H, 4 pole.
1—45 K.W. G. E., 125 volts, Form H, 4 pole.
1—45 K.W. Edison, 125 volts.

Direct and alternating current motors—all sizes. Electrical repairs of all kinds.

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COMMONWEALTH EDISON CO.

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DYNAMOS, ARMATURES, MOTORS, ARC LAMPS, INSTRUMENTS, HIGH GRADE MACHINE WORK OF ALL KINDS

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It will put that high gloss on the commutator you have so long sought after

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2 7½-H.P., 500-Volt, General Electric Motors.
1 120-K. W. Westinghouse, General Electric, single phase.
1 No. 9, Arc Wood Dynamo.

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KENT, OHIO

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1—150 K.W. type A. T., form B, three phase, 60 cycle, 2300 volt, 600 rpm, G. E. alternator, exciter, panel board and instruments.
1—120 K.W. type A. S., single phase, 60 cycle, 2300 volt, 900 rpm, G. E. alternator, exciter.
1—100 K.W. type A. M., single or three phase, 60 cycle, 2300 volt, 900 rpm, G. E. alternator, exciter.
1—90 K.W. type A. S., single phase, 60 cycle, 2300 volt, 900 rpm, G. E. alternator, exciter.
1—150 K.W. type A.M., 1100 volt, 133 cycle, 835 rpm, G. E. alternator, exciter.
1—100 K.W. 250 volt, C & C generator, direct coupled to 135 H.P. C & C motor.
2—60 K.W., M. P.-6, 125 volt, compound wound, G. E. generators, direct connected to Harrisburg Ideal engines, latest type.
2—75 K.W., M. P.-4, 125/250 volt, G. E. generators.
One 12x14 and two 11x12 Harrisburg Ideal automatic engines, sub-base.

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Engines, Boilers, Alternators, Motors and Generators

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Manufacturers Lava Electrical Insulation
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READY TO SHIP.

Generators A. C.	Generators D. C.
500 K.W. West'ghouse 60 cy., 3-phase.	1000 K.W. G. E. 220-250 volt, dr. cn.
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800 K.W. Westinghouse, 60 cy. 2 ph., dr. cn.	
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100 " 6 " Walker, to Watertown Engine.
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60 Cycle Alternators 125 Cycle

180 K. W. West., 3 P., 1100-2200 V. 72 K. W. Stanley, 2 P., 2200 V.
150 K. W. West., S. P., 1100 V. 45 K. W. West., S. P., 1100 V

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220-Volt, 2-phase, 60-cycle A. C. Motors
1 50-H. P. General Electric, 900 R. P. M., Form K.
1 35-H. P. " " 900 " " " " " "
Both new and complete with Silent Chain Drives
Send for Complete List

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38-H P, Bachus Gas Engine.
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In first-class condition, but being replaced by Boston Edison Electric Power.
Apply to United Printing Machinery Company, Bartlett Square, Jamaica Plain, Mass

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WANTED AT ONCE

One 200 or 300 K.W., two-phase, 60-cycle, 2400-volt Alternating Current Generator; also engine to suit same. Direct connected or belted type. Must be in first-class condition. *Address A. C. S., care of Electrical World, New York.*

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POSITIONS WANTED

(*Continued from page 74.*)

ELECTRICAL ENGINEER, now occupying the position as constructing and operating engineer in one of the largest corporations in this country, is desirous of making change; has held present position for the past 15 years, and is well known throughout the United States; would be pleased to correspond with any one desiring the services of an electrical engineer, but could not accept any position offered under three months, unless agreeable to the company now engaged with. All correspondence to be considered confidential. Address No. 4028, care of Electrical World, New York.

WANTED.—Position as general superintendent or manager, age 39; entire time since I left college spent in public utility work, street railway, electric light, power and gas; filled positions as engineer, superintendent, general superintendent and manager; education paid for. Address No. 4034, care of Electrical World, New York.

POSITION WANTED as contract agent or solicitor in new business department of an electric light company, or am capable of assuming charge of complaint or collection departments; experienced and able to produce results; references furnished and correspondence solicited. Address No. 4038, care of Electrical World, New York.

POSITION WANTED by a technical graduate familiar with all branches of the electric light and power business and construction work, inside, overhead and underground. Would prefer to be superintendent or electrician of a company, but am open for any offer; am married and of excellent habits; have been in the business since 1893, after a year in the factory of the General Electric Company; good references from my three other employers. Address W. Y. E., care of Electrical World, 590 Old Colony Building, Chicago, Ill.

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The rate for "Help Wanted" advertisements of forty words or less is one dollar and fifty cents an insertion; additional words three cents each, payable in advance. Remittances and copy should reach this office not later than Monday, 5.30 P. M., for the next succeeding issue.

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TECHNICAL, Business and Sales Positions, $600 to $10,000. Twelve offices, we reach the entire world, and offer thoroughly capable men a service not to be found elsewhere. Our Magazine opportunities describes many positions now open. Copy free for the asking. HAPGOODS, 305 Broadway, N. Y.

CONTRACT AGENTS, power experts and solicitors wanted; we are placing commercial men with lighting companies throughout the country, and can offer exceptional opportunities to men with the right experience. The Commercial Exchange for Electrical Men, 56 Clinton St., Newark, N. J.

HELP WANTED.—First-class switchboard builder, capable of estimating, designing and laying out all kinds of switchboards, also panel boards and cabinets. Should be thoroughly capable and reliable. Address No. 3925, care of Electrical World, New York.

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WANTED.—To buy electric lighting plant in a good town of from 4000 to 10,000 inhabitants. Address, with particulars in regard to equipment and terms, No. 4030, care of Electrical World, New York.

PROPOSALS

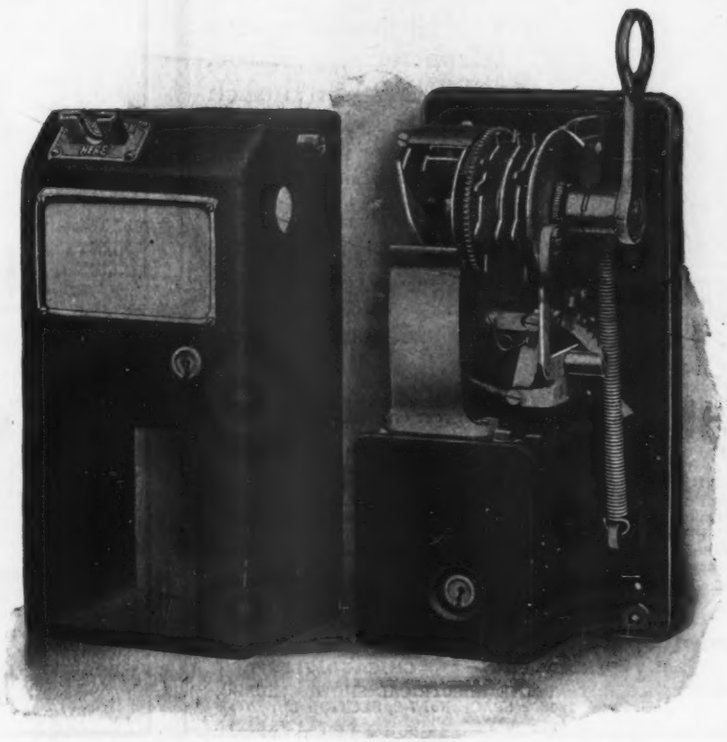
The rate for "Proposal" advertisements is 15 cents per line, payable in advance. Remittances and copy should reach this office not later than Monday, 5.30 P. M., for the next succeeding issue.

DEPARTMENT OF THE INTERIOR; Office Superintendent, U. S. Capitol Building and Grounds, Washington, D. C., Nov. 23, 1907. In accordance with the terms of the advertisement issued by this office, and dated Nov. 21, 1906, calling for equipment for the heating, lighting and power plant for the U. S. Capitol and Congressional Buildings, proposals will be received and publicly opened at this office at 12 o'clock, noon, Wednesday, Jan. 15, 1908, for boiler feed pumps, barometric condensers, centrifugal pumps, motors, cranes and chimneys. Bids will be submitted for each item separately. Each proposal must be in duplicate and accompanied by a certified check or approved surety bond in the sum of five per cent (5 per cent) of the total amount of the bid. The right is reserved to reject any or all bids, and to waive technicalities or informalities. Elliott Woods, Superintendent U. S. Capitol Building and Grounds.

One-Slot Pay Station

The cut shows our No. 13 Coin Collector which is designed for use on magneto or common battery lines and is arranged to take nickels, dimes and quarters.

The mechanism, which is mounted on the iron base and enclosed by the iron case, is positive in its action and is most substantially constructed. The case is finished in black Japan, and the lever, coin slot and instruction card are nickel-plated.



Attractive in Price — Satisfactory in Operation

The maintenance man has no access to the coin box, as its cover is entirely independent and is locked by a different key from that of the outside case.

The locks on both case and coin box are arranged so that the key can be withdrawn only when the bolt is extended.

Having but one slot, it insures placing the coin in the right place and prevents the user inserting more than one coin at a time.

Trained operators are not required, as the signals do not differ from each other in kind or intensity, but by number—one stroke of bell for nickel, two strokes for dime and three for a quarter.

Coins of other denominations do not operate signal.

Price of this Coin Collector and a Folder giving a full description will be gladly sent upon request

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Manufacturers and Suppliers of All Apparatus and Equipment used in the Construction, Operation and Maintenance of Telephone Plants

New York	Atlanta	Cincinnati	Chicago	Des Moines	Kansas City	Dallas	Salt Lake City	San Francisco
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NORTHERN ELECTRIC & MANUFACTURING CO., LTD., Montreal and Winnipeg

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See Our Exhibit at the Chicago Electrical Show

¶ Private Branch Exchange Switchboard Cabinet No. A-2766 Capacity 60 Local Lines, 10 Trunk or Exchange Lines.

"Lost Time is Lost Money"

¶ Of all time savers the **telephone** is the greatest.

¶ The **Private Branch Exchange Equipment** meets every requirement of the Modern Business Establishment.

¶ Connects offices, departments, buildings quickly and economically **without loss of time.**

¶ The time saved your manager, superintendent and employees by having a telephone system throughout your establishment will pay the cost of a system many times.

¶ Send us a plan of your factory or office—indicate where telephones are desired, and allow us to describe a suitable system and tell you how much it costs.

¶ Our No. 80 Booklet "Lost Time" describes systems for every condition. We mail it free to business men interested in the subject of saving time—increasing profits.

¶ Manufacturers of **Switchboards** for any size system—**Telephones** for any kind of service.

¶ Take Time—In Time—Ere Time Be Lost.

OUR TIME IS YOURS—WRITE TO-DAY

Stromberg-Carlson Telephone Mfg. Co.

ROCHESTER, N. Y. CHICAGO, ILL.

SEE OUR EXHIBIT AT THE ELECTRICAL SHOW, CHICAGO, JAN. 13-25, 1908. SPACE No. 7-8, SECTION L

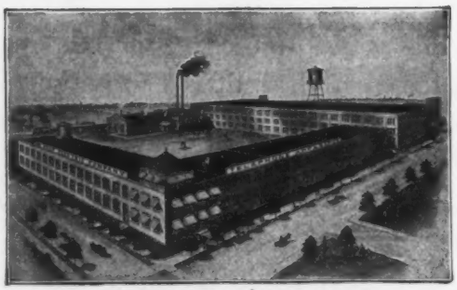
THE

American Bell Telephone Company

125 Milk Street Boston, Mass.

"DEAN"

GET OUR Brown Booklet



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ELYRIA OHIO

KELLOGG SWITCHBOARD AND SUPPLY COMPANY

Address Dept. D. CHICAGO

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ELEPHANT BRAND "Phosphor Bronze"

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ORIGINAL AND SOLE MAKERS IN THE U. S.

STAY AT HOME AND LET YOUR VOICE TRAVEL

You can accomplish more in a shorter space of time and at less cost

BY TELEPHONE

than you can accomplish in any other way.

NEW YORK TELEPHONE COMPANY
15 Dey Street

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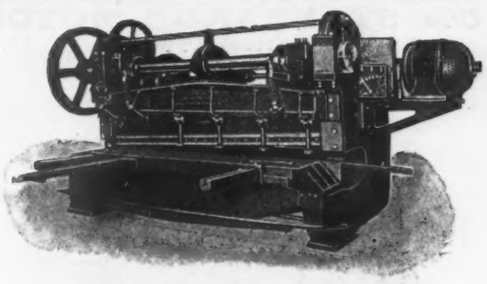

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Motors may be attached to all kinds of machinery with the best results because they are liberally rated, efficient and compactly built.

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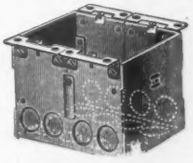

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Vertical Type

Motors of this type are useful for many purposes, such as for operating radial drills, centrifugal pumps, routers or any form of machinery where the main driven shaft is vertical.
"The Standard" Vertical Motors are made from the smallest sizes up to 15 H.P. for all direct current circuits. Provision is made for ample but cleanly lubrication, and the weight of the armature is carried on an efficient ball thrust bearing.
If interested in Vertical Motors for any purpose
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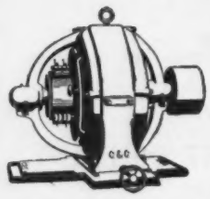
Do You Know That
C & C Type "S" Motors



whether doing **Constant** or **Variable Speed Work**—whether **Belted** or **Geared**—run **Cooler** than all other motors, have **Greater** overload capacity than all other motors, with positively **Sparkless** commutation?

A Superior Motor
In a Class of Its Own

Ask for Bulletin 150 M.

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Branch Offices
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Agencies in All the Principal Cities

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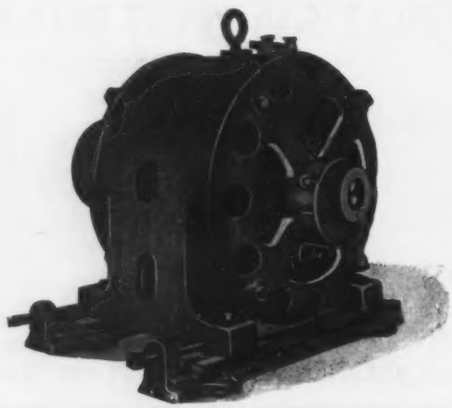

Where a Strong Starting Torque and Automatic Operation are desirable, a

CENTURY SINGLE PHASE
SELF STARTING MOTOR

will give results that will satisfy you in every respect.

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Direct and Alternating Current
for Every Service
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Pumps, blowers, conveyers, fans, crushers, etc., easily arranged for Northern Motor Drives. Motors readily applied to old belted machines as well as new. CONVENIENT, ECONOMICAL, RELIABLE POWER.
Leaflet 1257 on motor-driven pumps.
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See our exhibit at the Electrical Show, Chicago, January 13-25, 1908.

Shop Costs

go down as the efficiency of your tool-drives goes up.

Inter-Pole Motors

make the most economical tool-drives.
Speed instantly changeable.
Ratios up to 6 to 1. Single voltage.
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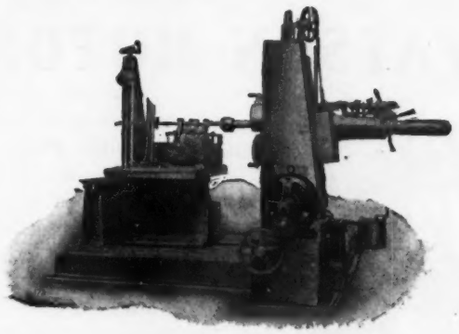

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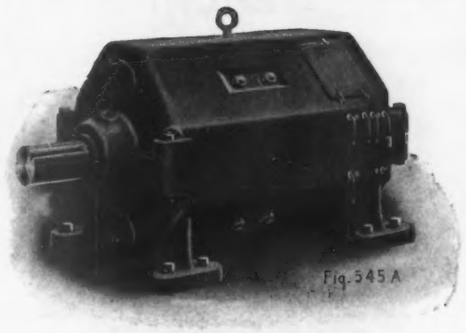
The **ONLY** motor



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of purely original design for rolling-mill service.

Our Form W Machine is already the STANDARD among mill men. See Bulletin 85-L.

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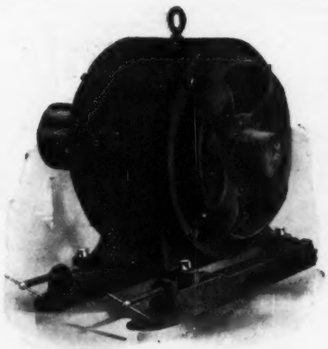

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Up to 3-4 H. P.
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Immediate
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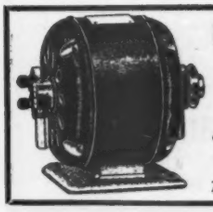

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For Direct Connection

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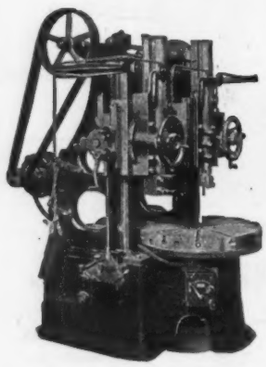

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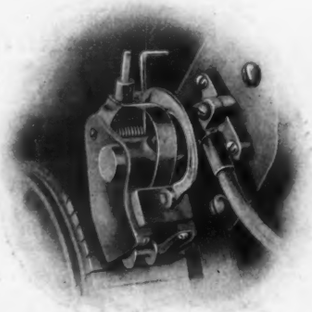

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1-24 H.P. to 20 H.P.

Type of Brush Holder used on Frames Nos. 1 to 20

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PROMPT DELIVERIES
Especially on parts made from rods ¾ inches or less in diameter.

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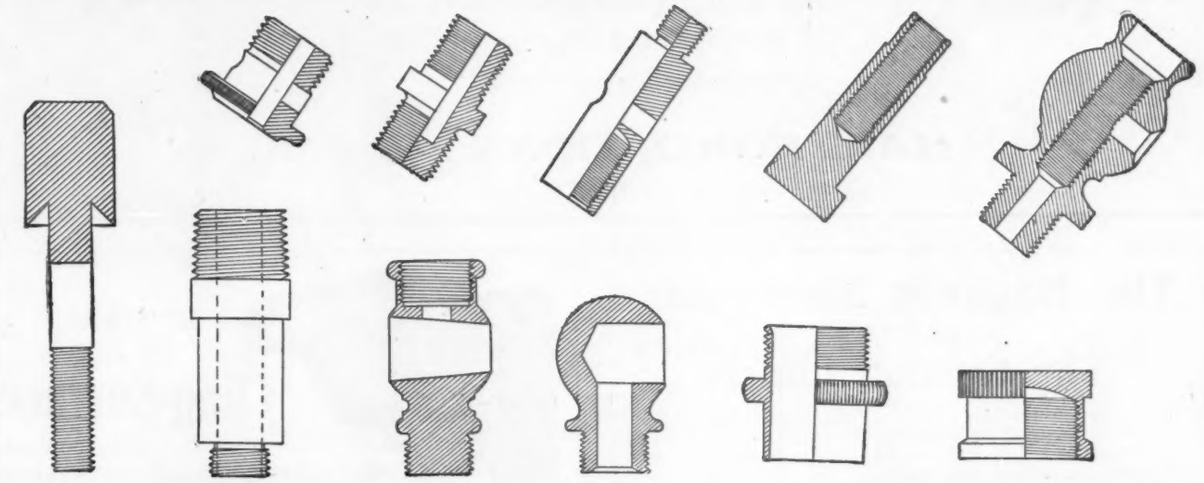

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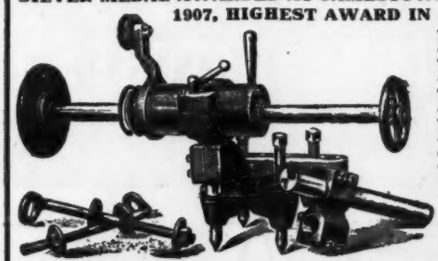

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Your belts will run easy or slack.

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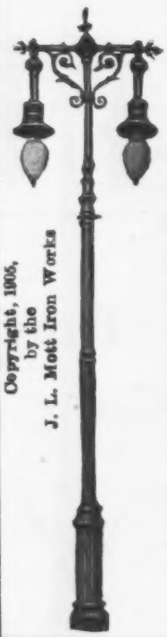

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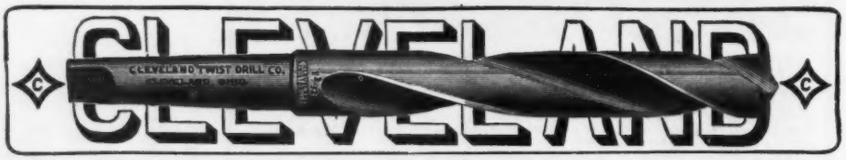

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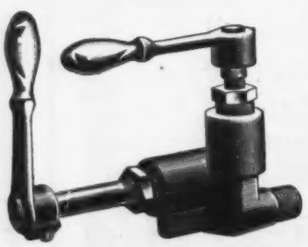

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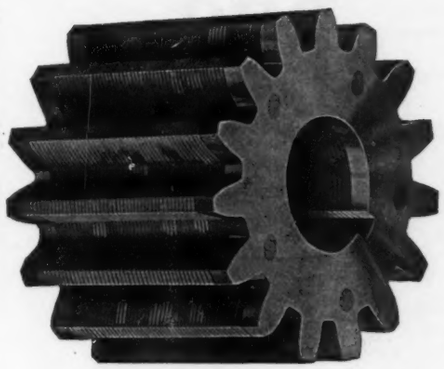

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and that whirring, ringing sound of your metal pinions is some of your money saying "Good-bye!"

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wear and work as well as cut-metal pinions, run without noise and reduce vibration.

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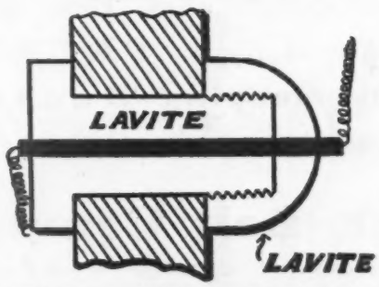
Not glass; it would crack and melt.

Not porcelain; it would crack also and cannot be accurately fitted to its support. 1/32 of an inch is close work for porcelain.

Not mica; it would deteriorate with heat in time and is weak mechanically.

There is only one insulator that you could use with entire success—

"LAVITE"



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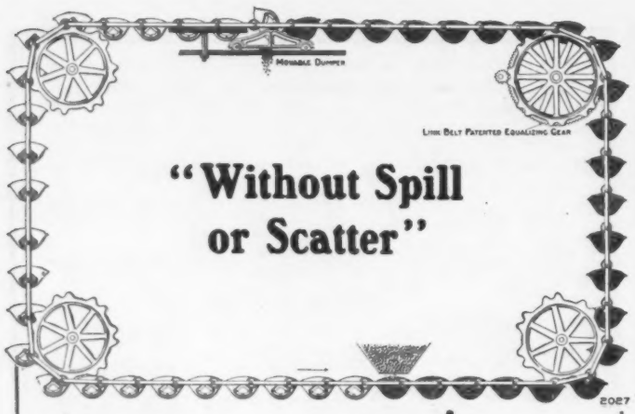

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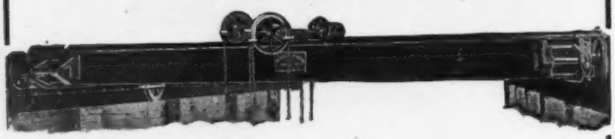

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make excellent hoists for the power house. Generally installed on a traveling crane, with trolley for cross travel. Are not out of commission when the power is off. Do not deteriorate when inactive and require little care.

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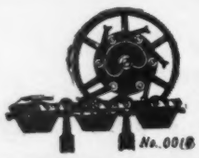

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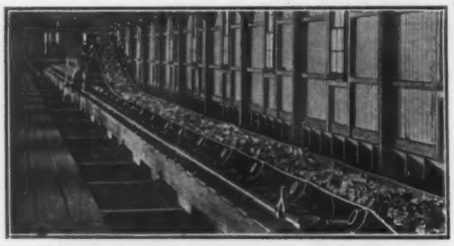

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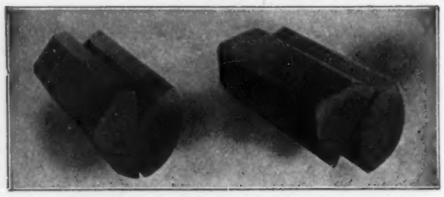

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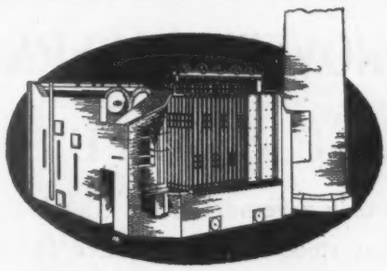

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An Economizer operated in connection with a boiler furnace for pre-heating the boiler feed water effects a saving of from 10 per cent. to 20 per cent. of the fuel. It protects the boiler from cold water and scale, and thereby reduces repair and replacement bills; it provides a large volume of water always in reserve at the evaporative point, ready for immediate delivery to the boilers to help in handling over-loads. The coal saving in a year alone will usually pay 25 per cent. to 50 per cent. of the first cost of the Economizer; while as for the up-keep charges on the machine, we are ready to guarantee them.

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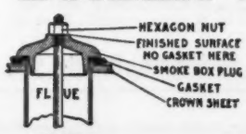
STANDARD
BOILER FLUE PLUG



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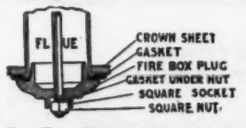

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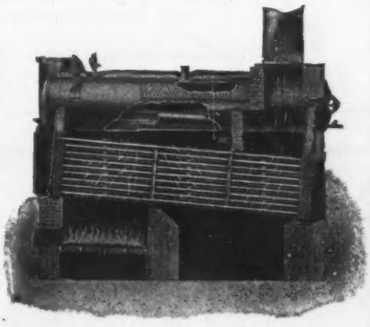

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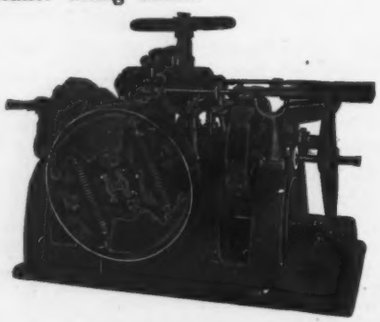

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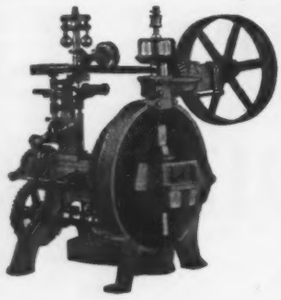

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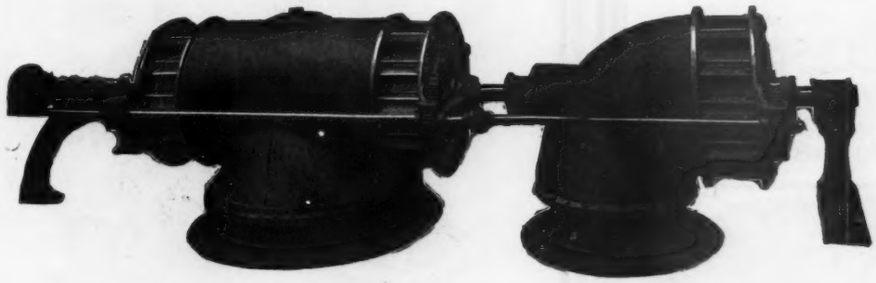

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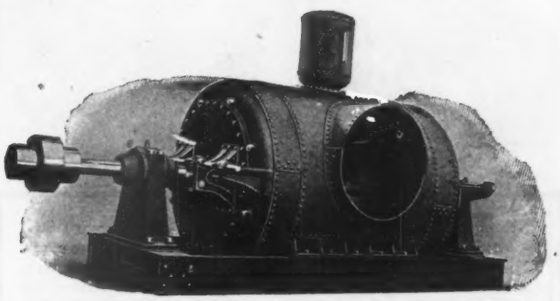

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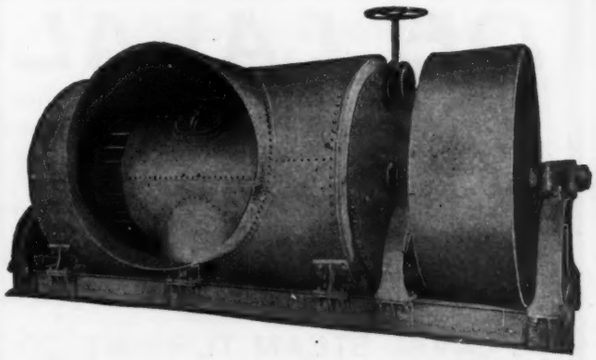

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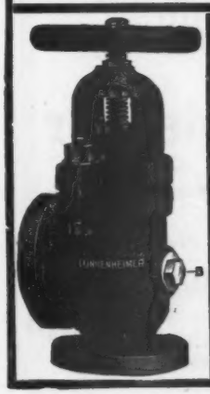

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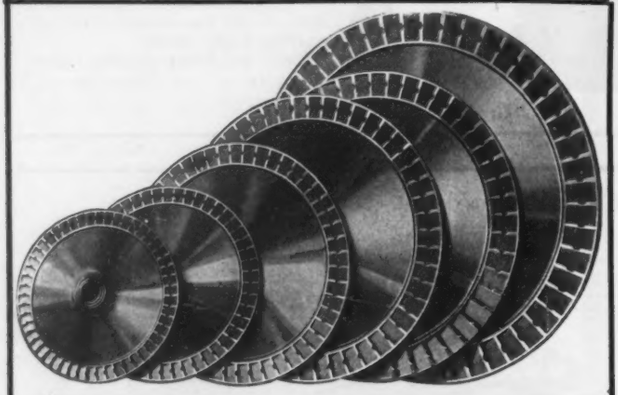

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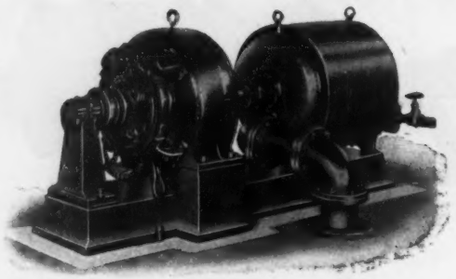

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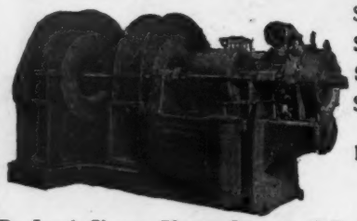

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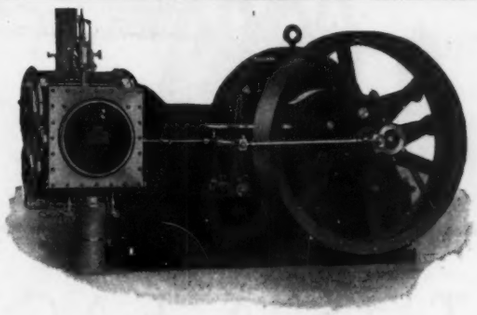

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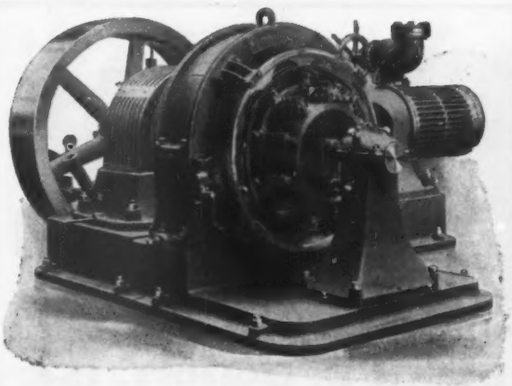

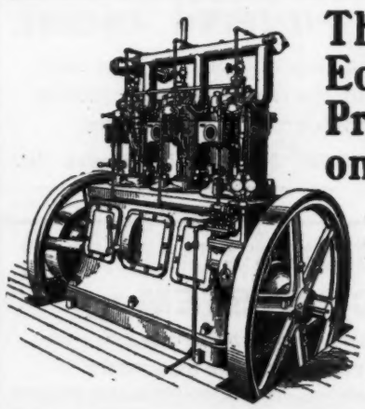

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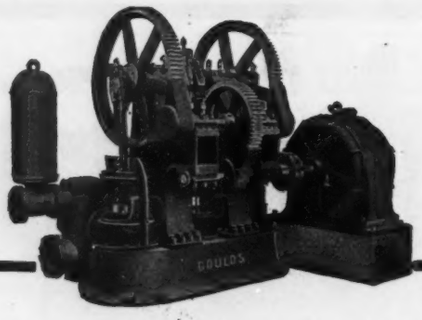

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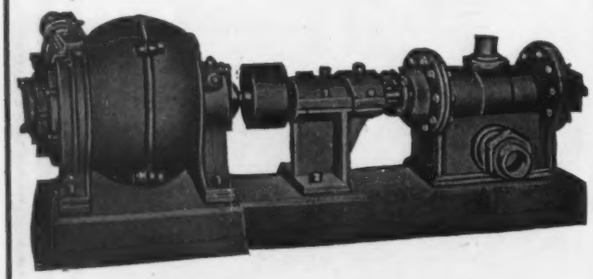

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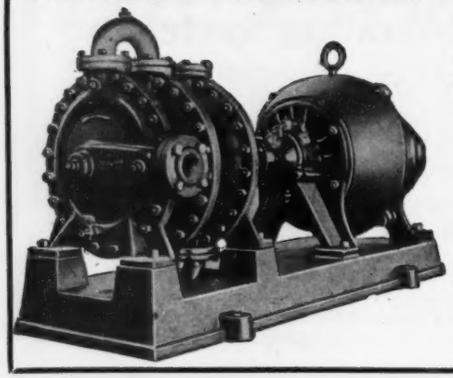

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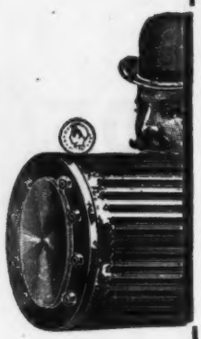

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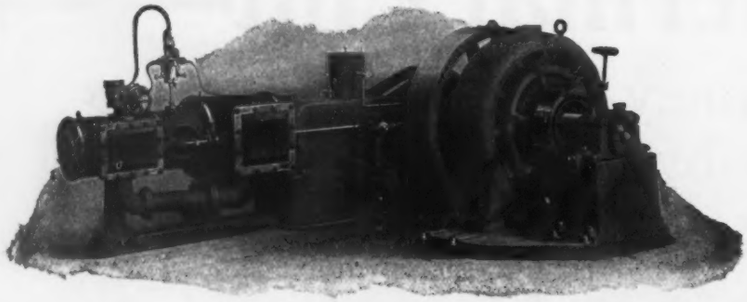

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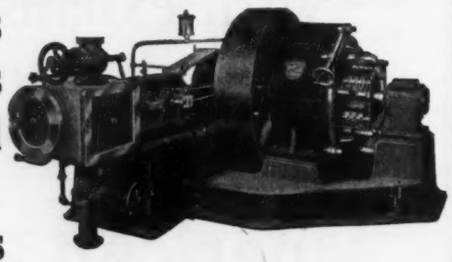

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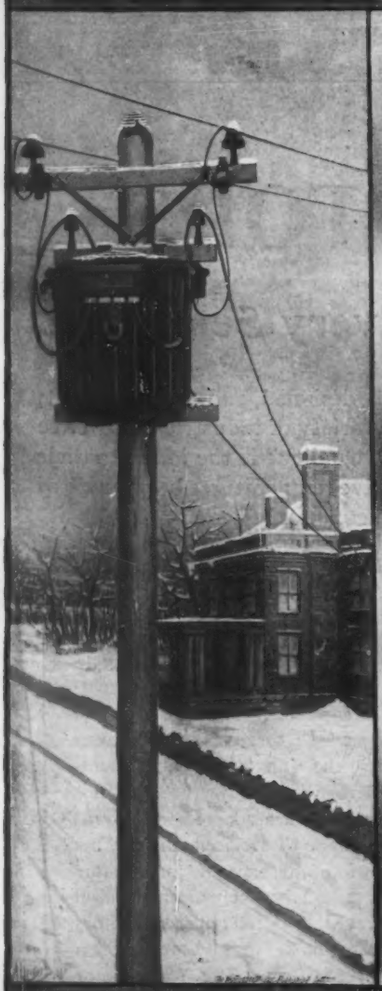

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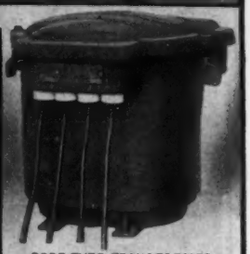

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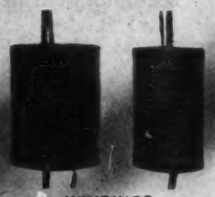

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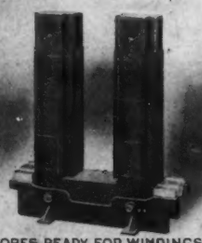

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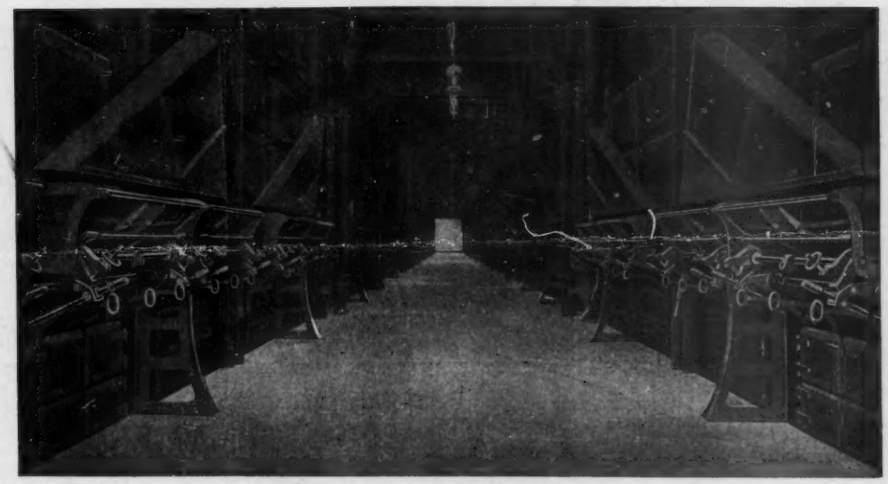

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